RECYCLING OF AGRO- INDUSTRIAL FOOD WASTES INTO FEED FOR PEKIN DUCK MEAT PRODUCTION TOWARDS A SUSTAINABLE AGRICULTURE IN THE PROVINCE OF QUEBEC.

By
Luc normand

A Thesis

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Dept. of Animal Science
Macdonald Campus of McGill University
Montreal, Quebec
Canada

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Luc Normand
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ABSTRACT

Recycling of industrial food wastes into feed for Pekin duck meat production.

Two experiments were carried out to assess the nutritional potential of food wastes to be transformed into duck meat. In both experiments, 600 day-old unsexed White Pekin ducklings were randomly distributed into 6 different dietary treatment groups. In the first experiment, half of the ducklings were started in chick battery cages for 7 or 12 days and the other half was raised directly in floor pens with wood shavings litter. The ducklings received commercial crumbled starter feed for 14 d before receiving their designated experimental diets. The experimental design, starting at 14 d of age, was 2 different blocks (light and heavy), 2 replicate pens of 25 ducklings in each block for each of 6 dietary treatments and thus a total of 100 ducklings per treatment. The control group received commercial pelleted feeds: a starter with 25.6% crude protein (CP) on a dry matter basis (DMB), a grower with 23.3% CP on DMB and a finisher with 21.3% CP on DMB. Treatment 2 received the commercial feed and a mix of chopped fresh vegetables. Treatments 3,4 and 5 received a mash feed formulated to contain 50% food wastes and 50% conventional feedstuffs (22.6% CP on DMB). Treatment 3 received also a mix of chopped fresh vegetables. Treatments 4 and 5 received a wet mash feed formulated to contain 18% CP on DMB (provided free choice) with the dry mash feed and water. Treatment 6 was designed to contain only food wastes. Starting at 14 d of age these ducklings received a dry mash feed (19.6% CP on DMB) and a wet mash feed (22.2% CP on DMB) and 35% dry matter. Feed

consumption was recorded weekly and calculated as DMB intake and individual body weights were recorded weekly. The feed conversion showed no significant difference ($P>0.05$) between Treatments 1 and 4 but Treatments 1 and 6 were significantly different ($P<0.0002$), Treatment 1 having the better feed conversion. The body weights at 49 d of age showed no significant difference ($P>0.05$) between any of the treatments and the control. In experiment 2 a similar experimental protocol was carried out. This time all the ducklings were raised in floor pens throughout the trial. The experimental diets were started at day one with a mash starter (24.4% CP on DMB) for 3 weeks and a mash finisher (22.7% CP on DMB) for 4 weeks. The control group received the same rations as in Experiment 1 and Treatment 4 wet mash feed was the same. All other diets were changed according to the availability of the food wastes and by improving the previous diets when possible. Treatments 3 and 6 had significantly better ($P<0.01$) feed conversion than the control. Treatments 3, 4 and 6 had significantly ($P<0.01$) higher live body weights at 49 d of age than the control. The carcass yield and composition of 3 different treatments in each experiment were compared. In Experiment 1, Treatments 1 (control), 4 and 6 were included and Treatments 1,3 and 6 in the second experiment. In both experiments, the ducks receiving food wastes had significantly ($P<0.05$) more total body fat than did the control. This was most likely due to the quantity of dietary fat ingested by the ducks. The results reported in this thesis indicate that it is possible to raise Pekin ducks to market weight using food wastes as the only source of feed. To meet the consumer demand of leaner carcasses, the food wastes with a high fat content should be included in a limited amount in the ration. The recycling of industrial food wastes into animal products could be considered an important step toward a sustainable agriculture system in Quebec.

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Recyclage des rejets de l'industrie agro-alimentaire dans la fabrication d'aliments pour le canard a chair de race Pékin dans le but de favoriser une agriculture durable pour la province de Québec.

Deux expériences ont été effectuées dans le but de démontrer le potentiel nutritionel des rejets de l'industrie agro-alimentaire dans l'alimentation de canards à chair. Dans les deux expériences, 600 canetons de 1 jour et non sexés de race Pékin ont été assujetis au hasard à 6 traitements alimentaires différents Dans la première expérience la moitié des canetons a été démarrée en cages métaboliques pour une durée de 7 et 12 jours, l'autre moitié, en parquet d'engraissement sur copeaux de bois. Tous les canetons ont reçu une moulée commerciale de début pour les 14 premiers jours et les moulées expérimentales ont été servies après ces jours de début. Les canetons ont été distribués dans un dessin expérimental de 2 blocs différents (légers et lourds) et 2 replicats par bloc pour un total de 4 parquets de 25 canetons et un total de 100 canetons par traitement. Le groupe témoin a reçu une moulée commerciale en granule avec une teneur en protéine brute (PB) basée sur 100% de matière sèche (BMS): un aliment de début (25,6% PB sur BMS), une moulée de croissance (23.3% PB sur BMS) et une moulée de finition (21,3% PB sur BMS). Le traitement 2 avait la même ration alimentaire que le traitement témoin avec en plus, des légumes frais coupés servis à volonté. Les traitements 3, 4 et 5 avaient une moulée qui contenait 50% de rejets alimentaires et 50% d'ingrédients conventionels, la valeur protéique de cette moulée étant

de 22,6% sur BMS. Les canetons du traitement 3 reçurent aussi un mélange de légumes frais coupés. Les traitements 4 et 5 avaient une moulée humide avec la moulée sèche. La moulée humide avait été formulée pour contenir 18% PB sur BMS. Le traitement 6 a été un traitement avec une utilisation de rejets seulement. Ainsi donc, une moulée sèche de 19,6% PB sur BMS était servie avec une moulée humide de 22,2% PB sur BMS et 35% de matière sèche. Chaque semaine la consommation alimentaire a été évaluée et reportée sur une même base de matière sèche. Le poids vif individuel a aussi été mesuré hebdomadairement. Aucune différence statistique ($P>0.05$) n'a été observée pour la conversion alimentaire entre les traitements 1 et 4 et les traitements 1 et 6 étaient statistiquement différents ($p<0.0002$), le traitement 1 ayant une meilleure conversion alimentaire. Le poids vif à 49 jours n'a démontré aucune différence statistique ($P>0.05$) entre tous les traitements lorsque comparé avec le traitement témoin 1. Dans la deuxième expérience, un protocole expérimental similaire à celui de la première expérience a été utilisé. Tous les canetons ont été démarré en parquet d'engraissement sur copeaux de bois à partir du premier jour et pour toute la durée de l'élevage. Les diètes expérimentales ont été servies à partir du premier jour avec une moulée de début de 24,4% PB sur BMS pour une durée de 3 semaines et une moulée de finition de 22,7% PB sur BMS pendant 4 semaines. Le groupe témoin 1 a reçu exactement les mêmes types de diètes que ceux de la première expérience et la moulée humide du traitement 4 a resté inchangée. Toutes les autres moulées ont été changées dans le but d'améliorer la performance des canetons. Les traitements 3 et 6 ont de façon significative ($P<0.01$) eu une meilleure conversion alimentaire que le groupe témoin. De plus les traitements 3, 4 et 6 ont eu un poids vif supérieur au groupe témoin ($P<0.01$). Le rendement et la composition de la carcasse ont été comparées dans trois des traitements de chacune des expériences. Dans la première expérience, les traitements 1, 4 et 6, et dans la deuxième expérience, les traitements 1, 3 et 6 ont été choisis. Dans les 2 expériences, il a été démontré que les canetons qui ont reçu des rejets alimentaires avaient de façon significative ($P < 0.05$) plus de gras que le groupe témoin. Ceci est probablement dû à la quantité de gras ingéré par les canetons. Les résultats de ces expériences indiquent qu'il est possible d'alimenter des canards de race Pékin à chair en utilisant les rejets de l'industrie agro-alimentaire. Pour rencontrer les besoins des consommateurs et avoir des carcasses moins grasses, une proportion différente de certains rejets dans la ration va permettre d'atteindre cet objectif. En recyclant les rejets de l'industrie alimentaire, le premier pas vers une agriculture durable sera atteint pour la province de Québec.

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GENERAL INTRODUCTION

The global human population is projected to be 8 billions by 2020, and this increase in population will require a greater food supply (Gardner, 1996). The required food increase is anticipated to be 64 % in the world and closer to 100% in developing countries (Gardner, 1996). The past few decades an intensive agriculture oriented to high production and excessive uses of fertilizer and pesticide, just to name these two, have resulted in land erosion with loss of the top soil and improper use of ground water. So far, people have used the natural resources to satisfy their economic goals without any consideration of the consequences for the future generations. Everywhere on the planet natural resources are used inefficiently, creating an environmental debt that is accumulating and perhaps will never be repaid. Interest in changing the methods of agricultural practice is gaining in popularity throughout the world and sustainable agriculture will be the first starting point towards creating a safer environment. It is time to change the view of agriculture by many people, from an agriculture viewed as pollutor, to an agriculture being environmentally friendly. It is well known that less and less land is available for agriculture, because it is given up to urbanization and it should be also mandatory to protect the natural habitat of the wild species to conserve biodiversity. But, still we need more food for the increasing population and wild animals for the survivability of the diversity on earth. Recycling of the industrial food wastes into animal feedstuffs, along with the other types of recycling (paper, glass, plastic) everywhere in the world is an essential starting point for a plausible solution.

There is already some recycling of food wastes into animal products but it is far from being fully exploited. For example, a study done by the Centre Québécois de la valorisation de la biomass (CQVB, 1993) estimated that the secondary sector or the agro-industrial sector of transformation produced 2,041,113 tons of byproducts or 296,738 tons of dry matter per year. This document estimated that 80% of those byproducts were in one way or another utilized in animal feeding. Therefore 20% or 43,297 metric tons of food wastes on dry matter basis are lost every year to landfill, incineration or in natural water systems. But these organic food wastes represent much more than a loss of dry matter, they are a loss of nutrients often edible for human consumption but simply discarded for many reasons. A second opportunity is lost if they are not utilized in animal feeding. These industrial food wastes represent much more than we think. For example, dry bread represents a loss of wheat; it includes lost costs of energy for seeding, harvesting, transporting, milling and since all these processes or steps are not 100% efficient, the loss of bread represents an enormous loss. The recycling of the food wastes represents a partial recovery of these losses. Poultry production is now being proposed as the possible solution to global hunger for the next century (Stackhouse, 1996). Poultry require less land than any other farm animals, ducks are a more advantageous species for some countries such as Asia, where the ducks weed pounds or rice paddies and help to control insects. For industrial countries the duck is a good species for recycling of food wastes because they have a great capacity of adaptation and will prefer foods high in moisture content, a characteristic of many food wastes. In addition, less processing would be required before it can be utilized to feed these ducks.

The objectives of this thesis were to recycle industrial food wastes from the industry located in the Greater Montréal region and to formulate diets using food wastes as ingredients providing a portion as the only ingredients of the diets. The first objective was to feed Pekin ducks with diets containing the food wastes and to compare the growth performance with that obtained using commercial feeds. The second objective was to feed these waste-containing feeds to ducks to reach the market weight of 3.2 kilograms at the same age as achieved by the industry. The aim was that the processing of the wastes would be minimal, only consisting of grinding and mixing. The final objective was to assess the effects of feeding food wastes on the quality of the marketable carcasses. The carcass composition especially the fat content would be closely monitored.

LITERATURE REVIEW

World wide food production situation

Grain, which supplies more than half of the daily calorie intake in the world, is a useful indicator of global food security (Gardner, 1996). Since mid century, the world population has doubled; at the same time, the demand for natural resources has also grown very fast. Since 1950, the need for grain has nearly tripled and the consumption of seafood has increased more than 4 times. Water use has tripled, demand for rangeland products such as beef and sheep has tripled. Firewood demand has tripled and paper need has gone up sixfold (Brown, 1996). Globally, the need for natural resources and food scarcity will become the principal limitations of population growth due to environmental mismanagement (Brown, 1996). Recent projections indicate that world population will exceed 6 billion people by the year 2000 (Parikh, 1988; Brown, 1989) and 8.5 billion by 2025 (U.N.,1991). Present and projected levels are far in excess of what cultivated soils can support from their own nutrient reserve or from natural recycling (Hossner and Dibb, 1992).

The evidence of the damage to the world ecological infrastructure takes the form of collapsing fisheries, falling water tables, shrinking forests, soil erosion and disappearing species or breeds with the loss of their genetic variability (Bown, 1996). Recently the scale of human activities reached a point where it affects the ability of the planet to survive (Brown, 1996).

By 1989 all oceanic fisheries were being fished far beyond capacity putting more pressure on land to compensate the need for food (Brown, 1996). The demand for seafood exceeds the sustainable yield of fisheries, the food required to feed humanity must come from the land by increasing production of crops and livestock. Hossner and Dibb (1992) mentioned that there are only two ways to increase agricultural production to feed the expanding population: expand the land area used for cultivation and livestock or produce more from land already under cultivation.

Today there is less and less land suitable for agricultural expansion in the world. All around the earth their is a loss of cropland due to urban growth. For example, Java loses nearly 20,000 hectares of cropland annually to urban growth, roughly the land required to grow rice for 378,000 Indonesians for a year (Gardner, 1996). Between 1982 and 1992 2,4 million hectares of farm land were lost to rural or urban developments mainly in the United States (Gardner, 1996). The development of modern agriculture in industrial nations has secured food surplus to nearly the entire earth population. But that modern agriculture is not without problems. Since World War II, it was estimated that one sixth of the world's vegetated area has suffered some degree of soil degradation and erosion (Gardner, 1996). Three quarters of this abuse is caused by agriculture and livestock production or by converting forests into cropland (Gardner, 1996). Agricultural mismanagement alone has damaged an area equal to 38 percent of today's cropland (Gardner, 1996).

One hundred years ago, producing more food required only to increase cultivated land (Gardner, 1996). In the mid 50's, the importance of land has lessened as agricultural inputs increased. Therefore the industrial cultural methods such as mechanisation, application of fertilizer and pesticides, irrigation, improved seed by creating new hybrids and cultivars contributed significantly to meet the food requirement (Gardner, 1996). In the USA for example, modern agricultural techniques have increased land productivities by more than 40 percent in the fifties and again in the sixties, but the productivity decreased by 20 percent in the seventies and 10 percent in the eighties (Brown, 1996). In the USA in the forties, farmers produced 56 million tons of corn using 31 million hectares of land (1.8 tons/hectare), in 1992, 230 million of tons of corn was produced on about 28 million hectares (8.2 tons/hectare) (Borlawy and Dowswell, 1993). Therefore, in the nineties the value of cropland for food production became the main interest and the excessive use of fertilizer today is not working anymore due to the loss of the organic matter by soil erosion resulting from modern agricultural practice. Therefore more and more fertilizer are lost by leaching causing other problems such as water pollution, disturbing water ecosystems leading to the eutrophication of lakes and rivers. The challenge for farmers in a landscarce world is to raise land productivity by using new or old agricultural practices but adapted to save the natural resources and to respect the fact that the productivity of the land is limited. To meet the food needs of the expanding population of 90 million people a year, production of food and other agricultural products may have to increase by 3.1 % per year (U.N., 1989). Therefore an annual expansion in grain production of 28 million tons is required (Brown, 1996). To meet that challenge, efforts in research and creativity will have to be accomplished. In fact, Hossner and Dibb (1996) reported that the number of hectares of arable land is expected to decrease until the year 2000.

In 1965, The world population was 3,027 billion people with 1,380 million hectares of arable land for a ratio of 0.46 hectare per person (Hossner and Dibb, 1996). In the year 2000 the population is expected to reach 6.2 billion persons and the arable land to reach 1,540 hectares for a ratio of 0.25 hectares per person (Hossner and Dibb, 1996).To expand food production we will have to expand the land area, but this will be difficult since it is limited and most of the time, urban areas will take over some cropland. Over all developing countries, specialists expect arable land area will expand by 12 % while population will expand by 47 % (FAO, 1993) We have reached the maximum capacity of the land already in cultivation to produce (Hossner and Dibb, 1996). It may also not be realistic to expect plant breeders to develop new varieties that will lead to doubling yields of existing varieties (Brown, 1996).

Trends to build on

Humanity is now facing a situation where the planet will not be able to supply enough natural resources to produce food to survive. Therefore, humanity represented by government will have to make some decisions such as building a future based on environmentally sustainable, global economy. As defined by Brown (1996)," a sustainable economy will be where human births and deaths will be in balance, soil erosion will not exceed the natural rate of new soil formation, tree cutting will not exceed tree planting, fish caught will not exceed sustainable yield of fisheries, cattle and range animals will not exceed carrying capacity, and water pumping will not exceed aquifer range". In such a sustainable world, the number of plant and animal species lost will not exceed the rate of new species evolving. A stable population is defined as one with a growth rate below 0.3 percent (Brown, 1996). Thirty countries have stable populations; most of those in Europe plus Japan. Like China, other governments will have to carefully balance the reproductive right of the current generation with the survival rate of the next generation (Brown, 1996).

In some countries, agriculture survives in part on water (ground water) borrowed from the future (Gardner, 1996). Only sustainable farming practices will allow agriculture to live within its means today and to begin to repay the resources debt of the past (Gardner, 1996). So far, the grain output has easily outpaced population growth for more than 30 years (Gardner, 1996). Chronic hunger in the world is decreasing; in 1969, one in three persons faced hunger daily, today, one in five (Brown, 1996). The carryover grains (food security) have shrunk to their lowest level ever, 49 days of world wide grain reserve in 1996 is predicted before the new harvest (Brown, 1996). The world grain reserve is affected by the increase in population year after year but also by the harvest yield that can vary due to temperature changes or natural disasters such as rain, flood, draught and insect invasion.

Gardner (1996) suggests that the best way to increase food use efficiency is to reduce the world consumption of meat. Thirty-eight percent of the world's grain is fed to animals (Gardner, 1996). It is true that animals are not 100 percent efficient in using grain, but on the other hand, we obtain in return a better source of protein, therefore better utilization for human. Examples of inefficient use of grain by farm animals are: 7 kg of grain represent 1 kg of beef, 4 kg of grain represent 1 kg of pork, and 2 kg of grain represent one kg of chicken (Gardner, 1996). In much of the world meat consumption is climbing steadily, so less and less grain is available for human consumption. Domesticated animals now outnumber humans three to one (Durning and Brough, 1991). The change in the economy of some countries brought the increase in animal production. For example, from 1991 to 1994, the Chinese economy expanded by 57 percent, raising the income per person of 1.2 billion people by more than half. The impacts: the Chinese people have shifted their consumption from grain to animal products, therefore China's shift from net grain exporter of 8 million tons in 1994 to net grain importer of 16 million tons in 1995 (Brown, 1996).

Feeding the world in the next centuries using sustainable methods of food production is an achievable goal. Reducing waste of virgin material and reducing loss during their processing will help in these objectives. In industrialized countries, creativity will have to be adopted. For example, recycling of organic food waste into animal feed will allow a development of a more sustainable agriculture and maximize the use of the virgin material.

Waste production and situation

A meaningful characterization of society can be made by examining what it throws away. Archaeologists learn about past civilisations by studying the various objects extracted from ancient dumps (Rhyner et al., 1995). The archaeologists of the future, if they do the same, will find that our society was a society of consumption of raw material and a discarding society (Rhyner et al., 1995). Garbage output continues to grow faster than population growth, as does environmental damage from waste disposal and the even greater damage of extracting, processing and fashioning materials into consumer goods (Young, 1991). A good example of this damage is the fact that every minute, 29 hectares of tropical forest disappear in the world to provide fire wood and land for pasture (La Presse, Montreal, Monday August 5, 1996).

The years following World War II (WWII) were very detrimental for the environment and the creation of the throwaway civilisation that we are in. During WWII, in Canada, and also other countries the level of resource extraction from waste materials was much higher than it is today because of the scarcity of virgin materials and restriction on imports (Maclaren, 1988). However, after these periods of worldwide crisis, the value of waste decreased and the emphasis on disposal returned. For example in the USA, after WWII the Americans created and exported a new lifestyle: consumerism (Young, 1991). Total sales of all the commodities produced by a country became a widely accepted indicator of its economic health. Emphasis on sales created a peculiar set of industrial standards (Young, 1991). As cited in World Watch Paper 101, a critic quoted in Vance Packard's The Waste Makers said: "Maximum sales volumes demand the cheapest construction for the briefest interval the buying public will tolerate". Therefore, convenience eclipsed durability as a top marketing point and the ensuing decline of durable and reusable products created the throwaway society. The definition or the concept of waste is not perceived the same throughout the world. For example, in developing countries, many materials or products that Canadians send to landfills are considered valuable resources and are recycled or simply reused as they are (Maclaren, 1988).

(a) Waste generation

USA residents threw away, on average, 662 kilograms of waste in 1988 and the total is expected to rise to 806 kilograms per person in 2010 (Young, 1991). Therefore it is estimated that each USA resident throws away 1.8 kg per person per day. In Canada we are following the same trend with 1.75 kg per person (World Resources Institute, 1994). Americans and Canadians generate twice as much garbage per person as do West Europeans or Japanese. The amounts of waste generated per capita per year are listed in the following table (Table 0.1).

Table 0.1: Municipal solid waste (MSW) generation per capita in selected countries.

COUNTRY	YEAR OF ESTIMATE	ANNUAL MSW kg
USA	1986	864
New Zealand	1982	670
Canada	1989	625
Finland	1989	504
Norway	1989	473
Japan	1988	394
England	1989	357
Germany	1987	318
Greece	1989	259

World Resources Institute, 1992

We can see in Table 0.1 the great variation existing between countries. The waste generation per capita is lower in some countries due to their politics of recycling. The twenty-seven municipalities of the Montreal Island, except the city of Montreal, generate approximately 700,000 tons of waste i.e. 600,000 tons of household waste and 100,000 tons of construction waste. These municipalities comprise 755,350 people; therefore, each person generates on a yearly basis 794 kg of household waste (City of Montreal, 1994).

(b) The typology of waste

There are three distinct waste streams which are normaly kept separate for the purpose of disposal. These are: municipal waste, hazardous waste and radioactive waste. Municipal waste includes waste from residential, commercial and institutional sectors as well as construction and demolition wastes, sewage sludge residues and incinerator ash (Maclaren, 1988). Hazardous waste comes from the industrial sector, households, institutions and from commercial establishments. The radioactive wastes are characterized into two categories mainly: high-level and low-level waste. The radioactive waste come from refineries, nuclear reactors, institutions such as hospitals and universities and from industries (Maclaren, 1988). Gaseous waste is a type of waste normally discussed separately because of its different management strategies. Table 0.2 compares the municipal waste composition in Canada (1976-77) and the municipal waste for the Montreal Island suburbs.

Table 0.2: Municipal waste composition in percentage.

WASTE	CANADA (1976-77) %	MONTREAL ISLAND SUBURBS (1988) %
Paper	36	32
Food and yard waste	34	-
Food waste	-	18
Yard waste	-	9
Glass	7	4
Metals	7	5
Plastics	5	7
Wood	4	6
Textile/rubber	4	4
Textile	-	4
Rubber	-	0.6
Hazardous waste	-	0.5
Other	3	13

Source Canada: V.W. Maclaren, 1988. Source Montréal: Régie intermunicipale de gestion des déchets sur l'Ile de Montréal 1994.

Table 0.2 represents the similarities between these two studies. Although the one for Montreal is more detailed, we can see that the trends in composition are similar with paper, the major waste, followed by food and yard waste. If the trend is the same for Canada, about 27 % of food ended up in the municipal waste stream. Based on the results done for the Montreal Island suburbs, (City of Montreal, 1994) 163,500 tons of food waste were lost in landfills or incinerated.

In 1992, Quebec citizens and the industrial, commercial and institutional sector generated 7.2 million tons of municipal solid waste which is equivalent to one ton per person. In Quebec, the breakdown of municipal waste was 33 % residential and 67 % from the industrial, commercial and institutional enterprises (Quebec, 1995).

The description of food waste includes uneaten food and food preparation wastes from households, commercial establishments like restaurants, hotels; institutions like hospitals, schools, food processors, grocery distributers and retailers. For example, in the USA, American families waste between 10 and 15 percent of the food they buy (Rhyner et al., 1995). Also a study done by the Illinois Dept. of energy and natural resources in 1991 described the amount of waste generated in public institutions: 4 to 8 kg per bed per day in hospital, 0.2 to 0.5 kg per student per day in school, and 90 kg per thousand dollars of sales in restaurants, (Rhyner et al., 1995).

(c) Industrial food waste production in Quebec

In 1993, a scientific committee including representatives from universities, governments, feed companies and veterinarians was formed by the Centre Québécois de valorisation de la biomasse with the mandate to identify the agro-industrial waste generated in the Province of Quebec. The goal was to evaluate the kind and volume of waste generated by the following agro-industrial food sectors: primary (farm level) secondary (transformation) and tertiary (retail), (Centre Quebecois de la valorisation de la biomasse, 1993).

The identification of waste produced was accomplished in 1993 with a representative sample of enterprises from eleven representative regions of the province. The inventories demonstrated that the agro-industrial food sector in Québec produced 2 million tons of by-products or 296,738 tons of dry matter. Most of these wastes are produced by the secondary sector such as dairy industries (1,626,599 tons), fisheries (31,702 tons), slaughterhouses (125,309 tons), dry product industries (53,480 tons) fruit and vegetable industries (120,797 tons) and the tertiary sector (30,177 tons). The study also demonstrated that 80 % of these wastes are already utilized or recycled in animal nutrition. Some examples include fish-, bone-, meat-, blood-,and feather meals, dried brewers grains, and dried whey. But six other industrial segments were identified where the utilization of the by-product by animals is at a low level and represents a rich source of nutrients for animals. These sectors are: cookie manufacturers (11,927 tons), canneries (8,424 tons), brewers (6,093 tons of yeast), and the tertiary sector (restaurant + grocery 5,051 tons), dairy industries (whey 3,462 tons) and bakery by-products (3,190 tons). The main interest in these sectors comes from concern for the loss of valuable nutrients which they represent and also from this low variation in composition which is valued in feed formulation. The study further stated that the interest in recycling these wastes is generated by the environmental constraints of disposal, government laws and the cost of disposal. For example, in Montréal, industries will pay disposal charges between $23 and $33 per ton of waste. In addition to the tonnage fee, they must pay $110 for pick up for each container and there is a cost of $100 for lift fee, rental of a compactor and $200 a month for the purchase and the maintenance of the compactor (Manne, 1995).

(d) Waste management options

The main option in the past was to put the waste in landfills. After the accumulation of waste in landfills, authorities looked for another solution: incineration. But these two methods are major sources of problems for the environment; landfill generally will cause pollution of ground water by leachate and by methane gas liberation. Incineration causes air pollution and, in fact, incineration is only an intermediate disposal method because ash must be landfilled after combustion (Maclaren, 1988). Some people believe that incineration is useful to create energy. However, a study done by Niessen (1978) demonstrated that incineration of food waste produced 1314 kcal/kg, a deficient energy process when we know that animals can obtain 2-3 times that energy value for their own growth. Composting of organic matter including household food waste is a good option to reduce waste, because the compost can serve as fertilizer. The focus now in most industrial countries is on the 3 R's waste management strategies. At the top of the hierarchy is **Reduction** of virgin material use. J.E. Young (1991) mentioned that the relative low price of virgin material often subsidized by government favors over utilisation of virgin material. **Reuse** and **Recycle** follow in the hierarchy. Waste reuse is defined as the utilization of materials or products in their original form for their original purpose with no need to apply physical or chemical treatments. In contrast, recycling of waste material or products requires significant physical or chemical treatment and often results in a product which differs in form or in use from the original (Maclaren 1988). Therefore composting is recycling and organic food waste utilized in animal feed is recycling also.

The principal strategy underlying the organic food waste coming from the agro-industrial sector in Québec and all other industrial countries is the creation of an input for an industry coming from the output of another industrial sector. Therefore, by-product wasted by the agro-industrial food sector is a valuable input or feed source for animal feed companies or directly for the farmer. So far in Canada and major industrial countries, emphasis on recycling is being adopted. For example, separate collection of household waste for paper, metal, glass and plastic is common in many municipalities. Most of the provinces in Canada have planned to reduce the amount of waste that are annually landfilled. Ontario and Québec, for example, have projected to reduce the amount of waste landfill by 50% by the year 2000. Furthermore, the main solution for food waste is composting (Maclaren, 1988). But again composting of household food waste is the best solution in our conditions and most of the industrial countries. In undeveloped countries most families keep ducks or pigs and feed them the table scraps. In such a way, these animals are considered as the" piggy bank" of the family. Therefore, most governments and individuals working for a better environment through recycling should consider food waste feedstuffs for animals thus recuperating at a higher value than making compost with it. The animals such as ducks using these organic food wastes will give in return a product of a high nutritional value for humans as meat and a fertilizing product as manure.

Duck production

(a) History

Duck production in North America started about in 1886 on Long Island, New York. Prior to 1873 some ducks were raised on Long Island near New York city but those ducks were small and of poor quality (Scott and Dean, 1991). Duck production really started by the introduction of Pekin ducks from China in 1873. The origin of this duck and the story of its transport to the USA has been recounted by several historians (Robinson, 1924; Wilcox, 1949; Hank, Skinner and Florea, 1974, Duna and Zhou, 1980) as reported by Scott and Dean, (1991).

(b) Origin

It is generally believed that the domestic duck originated from the green-headed mallard *Anas platyrhynchos* (D.J.S. Hetzel, 1985). There are nearly forty species in the genus *Anas* of which a number successfully hybridize. Wild mallards are found throughout the world but are concentrated in the northern hemisphere. In that genus we will find breeds like Pekin, Aylesbury, Rouen, Gray Calls, Khaki Campbells and Indian Runners. The Muscovy duck belonging to the genus *Cairina* is native to Central and South America (O. Grow, 1972). Crosses between the two genera are sterile (Hetzel, 1985). However, these crosses are practiced in China and France to improve the carcass of the progeny. In China, the mule duck is the end product of three-way crossing of the White Tsaiya, Pekin and Muscovy. In France a two way cross between Pekin and Muscovy and it is called Mulard or Mullard (Scott and Dean, 1991). Unlike the Pekin where the adult male and female are approximately the same size, the adult Muscovy expresses a sexual dimorphism in size, the male being 35 to 50 % bigger than the female (Scott and Dean, 1991). The male duck is identified as the Drake and the female retains her generic name of duck while the immature individuals are called ducklings (O. Grow, 1972).

(c) Breed and their utility

Pekin and Aylesbury are fast growing and best adapted for the green duck trade (ducks sold at young age, 7 to 10 weeks). The egg-producing breeds consist of the Runners, the Campbells and some strains of Buff Orpingtons. In the roasting duck category will be found the Cayugas, Crested, Muscovies, Rouens and Swedish. Some breeds are kept for general purpose, meat and egg production such as the Orpingtons, some strains of Buffs, the Runners and Campbells. Each class of duck is bred to fill a particular niche in the duck propagating economy and should not be perverted to functions it is not designed to perform (O. Grow, 1972).

(d) Use of ducks throughout the world

In Indonesia, the traditional systems of layer flock management have long been associated with wet lowland areas important for the production of major food crops such as rice. In Java the ducks are managed on a herding system. The herdsman moves his birds through harvested rice fields to feed his animals. The eggs are laid during the night, collected in the morning and sold to a local buyer the same day (Evans and Setioko, 1985). The feed of the ducks consists of whole rice grain fallen in the water, snails, insects, leaf material, freshwater crabs, frogs and unidentified particulate material. It is believed that for egg production the ducks get their required calcium mainly from the snails (Evans and Setioki,. 1985). Therefore ducks are used in those areas as insect control in rice paddies and most countries having that type of crop will utilize ducks for that purpose.

Duck/fish farming is a widespread practice in China, Indonesia, Malaysia, Singapore, Thailand and Other countries of that area (Scott and Dean, 1991). It is an integrated farming type of operation. The ducks receive complete pelleted feeds and the fish usually receive some pelleted feed in addition to that spilled by the ducks. Plant growth is increased by the use of manure produced by the ducks. Most of the ducks, in these countries are dual purpose; after egg production, birds are consumed for their meat.

(e) World distribution and consumption of ducks

Hetzel (1985) stated that 75 % of the world's domesticated ducks are found in South and East Asia. It is believed that 60 % of ducks are found in China (Turcotte, 1995). Table 0.3 is a brief overview of duck production in some parts of the world with emphasis on South East Asian countries for their importance in the world's production of ducks.

Table 0.3: **Duck population in different countries of the world**

COUNTRY	DUCK POPULATION IN MILLION	REFERENCE
Taiwan	30	Scott and Dean, 1991
Thailand	22	Wisuttharon, 1985
USA	20	Dean, 1985
Bangladesh	12	Ahmed, 1985
India	10	Bulbule, 1985
Philippines	5.5	Coligado, 1985
Canada	2.8	Agriculture Canada, 1988
Australia	1.5	Diggy and Leaky, 1985

It is obvious by the repartition of ducks in the world that people from the South East Asian countries are big consumers of duck meat, eggs, and ballut (duck embryos of 14-15 d old). Duck is most popular with people originating from Pacific rim countries and some from European background like France, Germany and Poland (Agriculture Canada, 1988). The consumption of ducks in Canada is estimated at 200 g per capita but is mainly consumed by those people who immigrated from the Pacific rim and Europe.

(f) Housing and management

As previously mentioned, a traditional herding system is prevalent in the Orient. Under this system, native ducks are selected for their ability to glean most of their food from harvested rice fields and insects (Scott and Dean, 1991). As originally established, typical housing for ducks on Long Island was located adjacent to creeks or other sources of fresh water in which the ducks could swim, with gently sloping sandy banks leading from the water to the houses where the ducks received their feed (Scott and Dean, 1991). But contrary to popular belief, there is no need to provide water such that ducks can swim or immerse their heads (Leeson and Summers, 1991). Ducks, however, do have relatively high water requirements and this is likely associated with the increased rate of passage of digesta (Leeson and Summers, 1991). The consequence is feces that contain 90 % moisture. Ducks will consume water approximately 4 to 5 times the weight of the daily feed intake (Scott and Dean, 1991). Therefore, ducks can be raised with no problem in an intensive way of production in closed buildings on slat floors or on wood shavings litter. However, in one study, Dean (1967) demonstrated significant improvement in weight gains ranging from 2-5 % in ducklings provided with water for swimming. But this improvement in hot weather may be due at least in part to the fact that ducks can dissipate heat from their feet to the water and through their bills (Scott and Dean, 1991).

(g) Duck advantages

Since the feeding and the management of ducks vary across the world, the duck is recognized to adapt easily to every situation. Ducks seem to be able to digest fibre slightly better than do chickens and as such, metabolizable energy values for ducks may be 5-6 % greater than corresponding values for chickens (Leeson and Summers, 1991). Scott et al (1959) demonstrated the tremendous ability of ducks to increase feed intake sufficiently to maintain normal growth, even with diets low in metabolizable energy that would have been entirely unsatisfactory for chickens (Scott and Dean, 1991) Also the duck is recognized as having great capability for compensatory growth.

(h) The duck industry in Canada and Québec

The Canadian duck industry is widely scattered across the country with four large producers accounting for 80 % of the ducks produced and slaughtered in Canada (Franchina, 1990). Table 0.4 illustrates the situation of duck production in Canada by the number of farms declaring raising ducks and the total duck slaughter in federally inspected plants in 1988.

Table 0.4: Number of ducks slaughtered in Canada (1988)

Province	#of farms reporting ducks	#of plants reporting ducks	#of birds processed	Eviscerated weight (kg)	%of total weight
Bri. Columbia	1,797	3	547,098	1,275,209	23.34
Prairie Prov.	7,115	6	299,785	654,848	12.01
Ontario	4,778	9	1,257,457	2,091,799	38.29
Québec	1,773	3	699,519	1,440,006	26.36
Atlan. Prov.	818	-	-	-	-
Total	16,281	21	2,803,859	5, 461,862	100

Source: Franchina 1990

Many small family farm operations raise ducks for local sale and home consumption. This explains why no real production of ducks appears in the Canadian production from the Atlantic Provinces. In Canada the majority of duck producers are farmers raising small flocks of ducks to supplement their income. Ontario and Québec accounted for 64.65 percent of the ducks slaughtered by weight in Canada (Franchina, 1990). Ontario is processing 38.29 percent and Québec 26.36 percent. King Cole Duck farm of Ontario supplies about 50 % of the domestic market and 80 % of the production in Ontario. Brome Lake Ducks of Knowlton in Québec supplies twenty one percent of the domestic market. Most of the ducks produced are New York dressed birds for the Chinese community (Franchina, 1990). The White Pekin is the only breed of significant commercial importance in Canada and the USA. In Québec, Brome Lake Ducks produces ninety three percent of the province's production.

<u>(i) Canadian market</u>

Most of the ducks in Canada are consumed by people of Chinese and to a lesser extent European origin. Some people will consume duck only on special occasions. We import from the USA the equivalent of about one fifth of our annual production, about 1 million kg of duck meat. There is no real market in Canada for duck by-products such as feathers, down, tongues, feet, liver, and gizzards. Duck tongues are exported to France, duck feet to Hong-Kong, feathers and down to the USA and livers and gizzards to Hong-Kong (Franchina, 1990). Other duck products are or will be in the market. We have already available the paté de foie gras de canard, some cut-up parts of duck like breast, breast with skin and other products such as duck hot dogs and marinated duck breast. In Canada it is expected that per capita consumption will increase due to the population growth, the increased immigration from China, South East Asia and also the development of new products.

Recent nutritional studies conducted by North Carolina State University ranked duckling and turkey lowest in cholesterol content in the poultry group, duckling is lowest in sodium also (Franchina, 1990). Compared to many red meat since duck is composed of red meat, duckling contains considerably fewer calories. So duck meat seems to be suitable for health-conscious people looking for food with fewer calories and lower cholesterol and sodium (Franchina, 1990).

Therefore the utilization of ducks for a recycling project is well justified. Ducks are able to adapt to various situations, are able to consume food to meet their energy requirements, seem to digest fibre more effectively than do chickens; and an increase in duck consumption in Canada is foreseen. It was also stated by Scott and Dean (1991), that the duck is a relatively good animal model for studies in pigs since they have similar digestive capacities.

In the context of food shortage and recycling waste, using ducks to produce human food out of their industrial food waste will be a big advantage and provide great opportunities to create new industrial expansion. Most of the ducks in the world are raised as scavengers where they are not in direct competition with man for food.

Because of the duck's remarkable adaptability to different environments and its ability to glean and subsist on feeding materials that are not retrievable by chickens, turkeys or other domestic animals, ducks do not compete with man for food to the extent that many farm animals do (Scott and Dean, 1991).

The law and recommendations for the utilisation of organic food waste for poultry and livestock.

Food wastes generally stem from four sources, raw material waste, food processing waste, post processing waste and post-consumer waste. (Lencki R. W., 1995). Over the years, the food processing industry has become centralized, moving from agricultural areas towards populated centres. (Lencki R. W., 1995). These industries produce huge quantities of wastes; some are picked up and utilized by local farmers, about 30 percent of more than 187 tonnes per week of substandard or expired food wastes from the dairies, bakeries and juice manufacturers in Toronto (Top, 1991).

Waste removal by farmers is generally not a convenient disposal method for the food processor (Top, 1991) or the farmer (Price et al., 1985). Certain provincial and federal laws limit this practice. This brings up the idea of the creation of a centralized collection facility that could potentially offer a more reliable service to the processor (Lencki, 1995). Norway currently has 19 centralized food waste sterilisation plants that collect waste materials and convert them into animal feed (Trenholm and Tibelius, 1991).

In the early nineties, the Canadian government undertook a Regulation Review encompassing all of its Acts And Regulations. The results of this review were recommended modifications of the section dealing with the Health of Animals Regulations, the garbage feeders regulation (Borman-Eby, 1995). The current regulations require that any one feeding "garbage" to swine and poultry obtain a license to do so (Borman-Eby, 1995). A person licensed to feed garbage to swine or poultry must boil the garbage thoroughly, prevent the swine and poultry from having access to any uncooked garbage and maintain the place of feeding in a clean sanitary manner (Borman-Eby, 1995). Garbage is defined as meat scraps, offal, kitchen waste, fruit, vegetable and other waste matter edible by swine or poultry (Borman-Eby, 1995).

(a) Disease risks

The regulations were originally put in place in the sixties to address concerns about hog cholera, foreign animal diseases, foot and mouth disease, swine vesicular disease, diseases of zoonotic concern (botulism, salmonella, sarcocystosis, tuberculosis, cycteriosis and trichinosis (Borman-Eby, 1995). Thus, the Federal Feeds Act and Regulations are designed to protect farmers, their livestock, the environment and the consumers against potential health hazards (Italiano, 1995).

(b) Definition of a feed

The Federal Feeds Act and Regulations defined a feed as any substances or mixture of substances manufactured, sold or represented for use for consumption by livestock, providing the nutritional requirements of livestock and serving the purpose of preventing or correcting nutritional disorders of livestock (Italiano, 1995). The situation where farmers themselves pick-up waste products from an establishment at no charge would be exempt from the Act, if and only if they are safe (Italiano, 1995). The farmer using those wastes will fall under the jurisdiction of the Health of Animals Act if they were feeding waste to poultry or swine. Once the establishment is involved in the production of feeds, it will be subjected to inspection and enforcement by field staffs (Italiano,1995). Some wastes are currently approved for animal consumption such as dehydrated bakery waste, dehydrated snack food waste, brewers grains and distillers by-products (Italiano, 1995).

(c) Animal slaughtering

Under the Federal Feeds Act and Regulations all animals receiving edible food waste directly at the farm must be slaughtered at a federally inspected plant (Borman-Eby, 1995).

(d) Recommendation for the utilisation of organic food wastes

When a farmer or an enterprise has the opportunity to utilize alternate feedstuffs they must take into consideration some important factors. Don Winslow (1995, Ontario Pork Producers' Marketing Board) suggests the following: the availability of the product, the distance and the form (solid or liquid), the safety of the product concerning the possible presence of plastics, aluminium, paper, toxic residues or antibiotics and the bacterial contamination. He also suggests considering the cost of the product as a feed ingredient, (transport, handling and animal performance). The consistency of the product such as the chemical analysis may vary and the product may have some effect on the meat quality, protein and fat quality, taste and texture. Also the waste product should have no negative environmental impact such as extra disposal of containers or wrapping. Anne-Marie Christen (1996) provided more detailed considerations that can be helpful for a producer interested in the experience of utilizing food waste or by-products as feed ingredients. First, she proposed to verify the safety of the product for the health of the animals and the people. The reliability of the waste producer regarding his cooperation, availability of the product, the freshness, the quantity available (daily, weekly, yearly basis). The number of enterprises with the same or similar product will be useful to know if huge quantities are needed. Due to the federal law the farmer should know if the product available is cooked or raw and if there is some study on the use of a particular by-product. Chemical analysis will be useful to know the nutritive value of the product and know if some nutrients such as sodium are in excess. The waste by-product should be palatable for the animal and highly digestible. Most of the producers are interested in utilizing waste have in mind to save money, therefore the cost of handling, transportation, storage, facilities required for the storage, corrosion by the product, bacterial spoilage can increase losses and increase the reluctance to use waste by-products. Favoring the perspective of maximal use of organic food waste in animal feeding presents a big opportunity to reduce the pressure on landfill sites (Winslow, 1995). Don Winslow (1995) emphasized the importance of using alternate feeds in a way that will maintain consumer confidence, consumer satisfaction and consumer support of the issue of recycling.

SECTION I

INVENTORY AND MANAGEMENT OF FOOD WASTE

This section will deal only with the procedures utilized before starting the project of feeding waste to ducklings. First of all, part of the project consisted of increasing the number of entries concerning waste producers and their products in a data base already existing at the Macdonald Campus of McGill University. This data base named "Inventory of commercial organic wastes in Greater Montreal" was created by Dr. E.R. Chavez and Dr. S.P. Touchburn. The next few lines will give credit to these initiators of a unique inventory of food waste for a city.

(a) Data base history

The data base inventory of commercial organic waste in Greater Montreal was originally presented to the City of Montreal in 1994. Its creation started in the fall of 1991 and within the year, 172 companies and institutions were contacted and 87 of them declared to be generating food wastes. In 1993-94, the city of Montreal requested access to the data base for a project of composting on a large scale basis. Therefore, at this time cellulosic wastes were added and of a current list of 467 companies contacted, 243 respondents provided estimates of their waste generation.

(b) Information on the data base

For each enterprise or institution in the data base, the information available includes the name of the enterprise, its location, the person contacted, the type of waste (different types of waste may be found at the same place), the quantity of each organic waste, the possibility of refrigeration, some specific comments and, when available, the current cost and means of disposal.

Samples collected were subject to proximate analyses performed in the Crampton Nutrition laboratory in the Animal Science Department of Macdonald Campus of McGill University. Further analyses were also conducted such as amino acid profile for wastes high in protein; fatty acid profile for wastes high in fat; mineral profile for wastes high in mineral content.

Table 1.1 shows the profile of the commercial food waste producers in Greater Montreal.

Table 1.1: Profile of commercial food waste producers in Greater Montreal

Type of enterprise	# of places contacted	# declaring waste	Quantity T/week	% of total waste
Abattoir	9	5	50	1.29
Army base	2	2	306	7.83
Bakery	36	22	33.8	0.88
Cafeteria	13	6	19.6	0.51
Dairy industry	9	7	1630	41.75
Food bank	7	5	50	1.29
Hotel	20	11	125	3.21
Hospital	42	22	48	1.23
Market	6	5	157	4.03
Prison	3	3	3.4	0.09
Produce retailer	111	67	51	1.32
Produce wholesaler	19	9	303	7.77
Quebec Hospital association *	1	1	100	2.57
Processor	149	45	918	23.51
Restaurant	8	2	18	0.47
Restaurant chains *	1	1	100	2.57
School	13	13	23	0.60
Schoolboard *	2	2	143	3.67
Sceptic tank	1	1	10	0.27
Wood trimming	15	15	111	2.85
Totals	467	244	4199.8	99.97

*these units are a collection of different waste generation sites

Source: Inventory of commercial organic wastes in Greater Montreal

Excluding the sceptic tanks and the 15 tree trimming companies, at least 4078 tons of organic food waste are available per week in Greater Montreal. Table 1.2 lists a part of the various kinds of products available to feed animals within Greater Montreal.

Table 1.2: Profile of available food wastes.

Type of wastes	# of locations	Quantity tons/week
Dairy by-products	7	1599
Fruit and vegetable	31	888
Mixed food	40	397
Grain	1	163
Bakery by-products	21	34
Total	100	3081

Adapted form Inventory of the commercial organic waste in Greater Montreal, 1994

(c) Methodology

One of the general goals of the research project was to increase the inventory of the data base. Therefore the starting point of the project was to do a prospection of new industries. The first approach was to telephone new enterprises in the food industry sector. The main tools used to find these new enterprises were the yellow pages of the telephone directory (1991-92) for the region of Montréal and the Répertoire des entreprise et des produits alimentaires du Québec, 1990. A fax was sent to those enterprises showing interest in the project of recycling,. The same sheet that was used to build the data base was used to get more information of the enterprises concerning their type of waste and the means of disposal. A copy of that sheet is available in Appendix 1. Following the return of the information sheet by fax from the enterprises, a meeting with the person contacted was planned to get further information and to take samples of the waste available for chemical analysis. After a selection of some waste available was based on their chemical analysis, quantity available, quality-freshness and physical form. Table 1.3 lists the name and location of the enterprises that have accepted to cooperate and to sponsor the project indirectly by giving their valuable waste for our interest at no cost. Table 1.3 also lists the type of waste, the quantity produced per week and the reason for disposal.

Table 1.3: List of compagnies, their location, type of waste and reason for rejection of food.

Company	Location	Waste Type	Qty/Week	Reason for Rejection
Best food	Montréal	peanut skin	600 kg	Skin removed from peanut for processing.
		peanut	100 kg	Rejected peanut.
Nutrisoya	St-Hyacinthe	okara fibre	300 kg	By-product of tofu production.
		tofu		Waste during processing.
Brasseries MGT	Montréal	brewers grains	10 tons	By-product of beer production.
Aliments Freddy	St-Hyacinthe	canned food	300 kg	Damaged cans over production.
		military meal	(20 tons inventory)	
Verona Imp.	Anjou	cookies	150 kg	Damaged packages.
Boulangerie Cachère	Montréal	bread	100 kg	Over production, old.
Aliments multibar	Anjou	granola bars	5000 kg	Processing losses, defective products.
Artel Cuisi-France	Bois Briand	pogo	300 kg	Defective products, beyond expiry date.
		pogo meat	time to time	
		pizza pockets	300 kg	
Restaurant Queen Elizabeth	Montréal	bread	300 kg	Over stock.
		vegetables	1500 kg	Trimmings.
Aliments Foo-lay	Brossard	noodle dough	500 kg	Processing losses.
Marché Jean-Talon	Montréal	vegetables	3000 kg	Undesirable shape, size.

(d) Waste selection

All the waste that we wanted to recycle into feed for ducklings were visually inspected for mold or apparent deterioration. Only in a few cases was rejection necessary and these products were relegated to composting. For example, all bread, cookies and vegetables found to be moldy were discarded without question. All the other wastes were collected as fresh as possible, usually immediately after being discarded. Thus, a good timing of waste food pick-up guaranteed fresher product. Most of the enterprises were highly cooperative, some of them froze the waste or kept it in a cool place. It is important to emphasize that most enterprises were interested in the project because they saw the opportunity of reducing their cost of waste disposal and some of them saw the possibility of finding a market for the waste.

(e) Criteria of waste utilization

The wastes were selected first based on their nutrient content (particularly crude protein), and their availability. Secondly one of the experimental goals was to utilize the waste without any processing except grinding to reduce particle size and facilitate mixing of the ingredients to make a complete feed. Chopping of the vegetables was also required in the wet diets.

(f) Food waste collection

All the food waste was collected with a truck (enclosed box) equipped with a tail-gate. No refrigerating unit was installed on the truck. Therefore, knowing the type of waste that we were dealing with, more fragile wastes such as meat were collected early in the morning and transferred to a cooler or freezer for storage. Except for the vegetables that were collected a few times a week, all the other wastes were collected the same day or the day prior to mixing. Plastic containers (400 L capacity) on wheels were provided to the enterprise as receptacle for waste collection in bulk, otherwise dry materials such as bread were picked up in boxes.

(g) Storage location and handling

The storage, chopping or grinding of the waste, and the mixing of experimental rations was conducted at the pilot recycling plant located on the Macdonald Campus. After mixing, the different feeds were transported to the Poultry unit on the campus. There the wet feeds were preserved by storing in the walk-in freezer until further needed. As the need arose, the feed was thawed in the walk-in cooler (Poultry unit) 24 hours before serving to the ducklings.

(h) Mixing

The experimental diets were formulated to meet or exceed the NRC (1994) nutrient requirements for ducks. Each food waste item was considered as a feed ingredient component of a complete diet. The test diets were prepared in batches of 200 kg. Minerals (Table 1.5) and vitamins (Table 1.6) were added based on the dry matter content of the diet. The vitamin and mineral components were mixed with about 30 kg of bulk ingredients in a Hobart mixer[1] for 15 minutes to assure their uniform distribution in the feed. This quantity was then added to the other ingredients in a large Davis batch mixer[2] for 20 minutes mix. After mixing, the wet feeds were transferred to plastic bags of 10 kg and frozen immediately. The same process of mixing was utilized for the dry and wet feeds. After each complete mix, a sample was taken for laboratory analysis.

Table 1.4 shows the analysis of the waste utilized in the project. The detail of each diet, composition, and chemical analysis of each are described in the specific experiments.

[1]Hobart Model V1401, Troy, Ohio, USA

[2]Davis Serial 4040-53-67, Bonner Springs, Kansas, USA

Table 1.4: **Proximate analysis of the food waste on dry matter basis**

Waste products	Absolute dry matter	Ether extract	C.P %	Ash %	G.E Kcal/Kg	ADF %	Ca %	P %
Okara	24.34	14.95	33.12	3.77	5134	12.93	0.27	0.46
Shepperd's pie	37.01	22.45	40.65	5.55	5289	0.99	0.04	0.36
Baked beans	35.28	3.40	19.33	4.85	4134	10.79	0.17	0.33
Lentils	23.33	1.16	26.32	9.82	3878	6.83	0.05	0.25
Noodle	44.90	4.45	15.47	0.32	4521	0.34	0.02	0.11
Granola bars	88.36	9.60	6.51	1.31	4811	0.79	0.06	0.15
Cookies	84.92	3.49	11.47	1.34	4249	0	0.11	0.25
Bread	92.31	3.65	15.79	1.88	4387	1.01	0.02	0.17
Pizza pockets	57.21	17.18	22.16	3.13	5048	0.99	0.25	0.30
Pogo	56.04	22.95	19.95	5.18	5068	0.78	0.29	0.26
Mixed Vegetable	17.73	1.86	14.44	3.93	4372	8.04	0.27	0.26
Brewer's grain	30.14	5.92	19.43	4.22	4193	21.20	0.33	0.55
Pogo meat	35.47	16.31	25.02	5.37	4858	6.63	0.87	0.88
Alfalfa	90.56	1.48	17.06	1.98	3961	12.9	1.37	0.31
Peanut skin	87,80	13.88	13.88	2.25	4864	34.1	0.33	0.09
Peanut	95.61	52.70	28.58	2.72	6634	13.1	0.04	0.27
Tofu	32.21	27.21	61.58	3.69	6267	1.21	0.29	0.89

* Analysis done at Crampton Nutrition laboratory, Macdonald Campus, McGill University

Table 1.5: Trace-mineral premix

MINERAL ELEMENT	AMOUNT MG/KG	SOURCE
Iron	95	Ferrous sulfate (36.8% Fe) $FeSO_4$ dry powder
Zinc	60	Zinc oxide (73 % Zn) ZnO
Copper	8	Cupric carbonate, basic $CuCO_3$ (55% Cu)
Manganese	60	Manganese oxide MnO_2 (55% Mn)
Selenium	0.2	Sodium selenite (45.6% Se) Na_2SeO_3
Iodine	0.4	Potassium iodide KI (76.4 % I)

To be added at 0.05 % of the diet based on 100% dry matter.

Table 1.6: Vitamin premix (amount/kg diet)
Growing-finishing ducks day-old to 7 weeks of age

VITAMIN	AMOUNT	SOURCE
Vitamin A	2,500 IU	500,000 IU/g
Vitamin D_3	400 IU	400,000 IU/g
Vitamin E	10 IU	500 IU/g
Vitamin K	0.5 mg	Menadione-bisulfate
Biotin	0.1 mg	2 % Conc. BASF
Folacin	0.5 mg	Folacin
Niacin	55.0 mg	Niacinamide
Pantothenic acid	11.0 mg	Ca-pantothenate
Riboflavin	4.0 mg	Lutavit-96%
Thiamine	2.0 mg	Thiamine-HCl
Pyridoxine	2.5 mg	Pyridoxine-HCl
Vitamin B-12	0.01 mg	1.0 g/kg = 0.1 %
Ethoxyquin or BHT or Santoquin	100.0 mg	99% purity

To be added at 0.05 % of the diet = 0.5 g/kg complete diet

SECTION II

GROWTH TRIAL 1

The objective of this study was to evaluate the feasibility of rearing meat-type ducks to market weight using industrial food waste.

The original idea to initiate this study (section II) was provided by Dr. E.R. Chavez and Dr. S.P. Touchburn. The research was supported by the Conseil des recherches en pêche et en agro-alimentaire du Québec.

ABSTRACT

Development of alternative food production systems for Québec.

1. Duck production based on recycled food wastes

The aim of this study was to evaluate the possibility of feeding ducklings to a market age of 49 days (d) by using as much as possible industrial food waste. Six hundred day-old, unsexed white Pekin ducklings were randomly distributed in 6 experimental treatments after receiving commercial starter diet for the first 14 d. One half were started in battery brooders for 7 or 12 d and compared to the other half started in floor pens. The treatments were: T1, control (commercial pelleted feed); T2, control supplemented with chopped vegetable waste fed separately; T3, a dry mash feed prepared on the Macdonald campus of McGill University formulated to contain about 50 % conventional ingredients and 50 % waste (22.6% C.P.) plus an additional chopped vegetable as T2; T4, the dry mash feed with a wet mash feed (37.3% D.M. 17.7% C.P.); T5 the dry mash feed with another wet mash feed (45.8% D.M., 17.6% C.P.) and treatment 6 (T6) formulated to contain only food waste: dry mash feed (19.6% C.P.) and the wet mash feed (35% D.M., 22.2% C.P.). The ducklings had free access to the feed in either form at all times. For each treatment, 100 ducklings were distributed in 4 pens of 25 as replicates. Body weight and feed consumption were recorded weekly. The average feed conversion values to 49 d showed no statistically significant difference between T1 and T4 but T1 was significantly superior to all the other treatments. The

body weight at 49 days of age showed no significant difference between any of the dietary treatments and the control. Only the differences between treatment 3 and 4 were significant ($p < 0.0055$) for body weight and average daily gain. Thus, the wet mash feed was superior and prefered to the chopped vegetebles alternative. These results demonstrate that it is possible to raise Pekin ducklings to market weight by recycling waste from the agro-industrial food sector. Therefore, it will be possible to reduce the volume of waste buried in landfill and the danger of pollution of the environment.

INTRODUCTION

In 1993, 2 million metric tons of wastes were generated by the industrial food sector in Québec. About 80% of this volume is already utilized for animal feeding and 20% disposed of by dumping in landfill or flushed into rivers. Feed manufacturers use wastes rich in dry matter and nutrient content which are available in large quantities year-round and require minimal transformation. When a producer utilizes various levels of waste such as bread, cookies, vegetables, whey or all unconventional feed ingredients they are described by some as garbage feeders. With the price of grain increasing,(corn $285 per ton and soybean meal at $403 per ton, La Terre de Chez-Nous, August 8 1996) the producers using industrial waste in their feeding program should be viewed as opportunists. Pigs and ducks are the most suitable farm animals for consuming industrial food waste with minimal processing. The production of pigs and ducks in many non-industrialized countries is currently based on direct feeding of household waste (Chavez, 1996). In the greater Montréal area 360,000 tons of recyclable food waste if used directly in duck production could be transformed into ready-to-cook 45,000 duck carcasses (100 tons of duck meat) (Chavez, 1996). Therefore, by promoting the maximum utilization of what is already produced as waste, the pressure on the environment could be reduced, favouring the development of a sustainable agriculture for the Province of Québec. The objectives of the present study were to design experimental diets meeting the NRC (1994) nutrient requirements for ducks, but formulated with different proportions and combinations of industrial food waste and to compare them to a control group receiving a conventional commercial pelleted feed in a typical feeding program. Pekin ducklings were fed to market weight of 3.2 kg or more in a 7 week experimental period.

MATERIALS AND METHODS

Animals

Six hundred unsexed, day-old Pekin ducklings were purchased from a private hatchery[3]. At arrival, 300 ducklings were placed at random in thermostatically controlled Petersime battery brooders[4] with raised wire mesh floors. The ducklings were distributed in groups of 10 per cage and were weighed as a group. For the first 3 days a crinoline cloth was put on the (1 cm x 1cm) wire mesh because the ducklings had difficulty to stand on the wire mesh. The ducklings received 24 hours of light (fluorescent). The other 300 ducklings were distributed at random and weighed in

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[3]Brome Lake Ducks Limited, Knowlton, QC, Canada JOE 1V0

[4]Petersime Incubator Co., Gettysburg, OH 45328

groups of 25 in floor pens with wood shavings litter. The ducklings were limited in a cardboard ring of 45 cm height, with access to a bell type waterer and a tube feeder. During the first 3 d feed was also available on cardboard trays to help ducklings to start eating. Extra heat was supplied with a hanging heat lamp (red). The ambient temperature in the battery brooder room was maintained at 30 °C and 32 °C under the brooder located in the cages. Similarly, in the building with floor pens the ambient temperature was maintained at 30 °C and 32 °C under the heat lamps at the floor level. The heat lamps were removed at 14 d of age. The cardboard rings were removed after 4 d, giving the ducklings access to the whole pen area. For the first 2 wks the birds on the floor received 23 hours of light and 1 hour of darkness but some light was supplied by the heat lamp. This was done to make sure that the ducklings accommodated to darkness. For the first week, because it was observed that ducklings in the floor pens were eating shavings, granit grit was provided to help physical grinding and to prevent shavings compaction in the gizzard. Half of the ducklings (150) from the battery cages were moved to floor pens at 7 d of age and the other half at 12 d of age. At 14 d of age, the lighting program was set at 6 hours of darkness and 18 hours of light from 4:00 AM to 10:00 PM and the light intensity was gradually reduced. The ducklings were individually identified with wing bands at 7 d of age and weighed individually. Feed and water were provided ad-libitum during the experiment. For the first 14 d, all the ducklings received a commercial crumbled starter[5] for ducklings. Feed consumption was recorded on a weekly basis and reported on a 100 % dry matter basis because of the dry and wet feed offered. All the birds were weighed individually weekly until 49 d of age.

[5]Meunerie Shur-Gain CPL, Ange Gardien QC, Canada

Experimental design

The 600 ducklings were randomly distributed in six different dietary treatments at 14 d of age. Duplicate pens of each treatment were assigned to 2 different blocks according to their body weight, heavy or light. In fact, all the ducklings that had a body weight over the average at that time were classified as heavy and those average or below as light. Thus, for each experimental treatment there were 4 pens of 25 ducklings for a total of 100 ducklings per diet. All the birds received the same space (0.23 m^2/ duckling) in a pen size of 3.08 m long X 1.85 m wide provided with wood shavings litter.

Building facilities

All the ducklings were kept at the Poultry Unit located at the Macdonald Campus of McGill University. The room with the floor pens had 4 exhaust fans of 45 cm diameter and 2 large ventilator fans of 80 cm diameter to maintain the air circulation inside the building. Two doors at the entrance and one at the other end that open to the outside were kept open after the first 14 d to increase the supply of fresh air.

Experimental treatment

Six different dietary treatments were evaluated in this experiment. Except for the control group, the feed was supplied in two different forms to the ducklings, as dry mash and wet mash. The control (treatment 1) ducklings received only commercial pelleted feeds as starter, grower and finally, finisher formula. Treatment 2 was the same pelleted feed but with a fresh mix of chopped vegetables offered ad libitum. Treatment 3 was a dry mash feed formulated at the Macdonald Campus and named Mac feed. This treatment was also provided a free choice fresh mix of chopped vegetables as treatment 2. Treatment 4 was the Mac (mash) feed plus a free choice of wet mash feed. Treatment 5 was the same as 4 except that the wet mash feed was different. Treatment 6 was formulated using only industrial food waste with vitamin and mineral supplements. All the diets were in first instance formulated using the dry matter content and the crude protein content of the waste products. The Mac feed was formulated to have 19 % crude protein and designed to use about 50% of conventional feedstuffs such as corn and soybean meal and 50% industrial food wastes. The dry mash feed treatment 6 was formulated to have 12% crude protein because it was the limiting factor in the utilization of the wastes that were available at that time. The wet mash feed for treatments 4 and 5 were designed to have 18 % crude protein on dry matter basis (DMB) and using different wastes in different proportions. The wet mash feed for treatment 6 was formulated to have 21 % of crude protein (DMB) to compensate in part for the low protein value of the dry mash feed for the same treatment. The chopped vegetable was provided as a free-choice alternative to the dry feed. The vitamins and minerals were supplemented based on the calculated dry matter content of each feed. No vitamins or minerals were added to the chopped vegetables. The composition of the diets is presented in Table 2.1 and their chemical analyses in Table 2.2. Table 2.3 gives the chemical analyses determined for the wastes utilized in this experiment. The analyses presented in Table 2.2 show the averages of several samples obtained from each batch of feed prepared.

Feed and feeding management

The ducklings were fed ad-libitum throughout the experiment. During the first 14 d all the ducklings received the same commercial starter feed. After this starting period, the ducks had free access and free choice of dry feed (pelleted or mash) and wet (chopped vegetable or mash) depending on the treatment. The feeds were added on a daily basis, especially the wet feed to avoid mold development. Any wet feed that was left in the feeder for more than 48 hours was discarded as compost. The dry feed was provided in a hanging tube feeder (capacity of $0.56m^3$) and the wet feed in an open trough with a capacity of 0.018 m^3 located at the floor level.

Table 2.1. Diet composition (% of the diet).

Ingredients	Mac Feed	Wet 4	Wet 5	Dry 6	Wet 6
Granola	17.0	10.0	20.0	13.0	10.0
Bakery waste[1]	16.4	-	-	35.0	-
Peanut skins	5.0	-	-	7.0	-
Alfalfa meal	3.0	-	-	-	-
Fish meal	3.0	-	-	-	-
Okara[2]	5.0	35.0	-	-	25.0
Barley	16.0	-	-	-	-
Corn	6.5	-	-	-	-
Soybean meal	17.0	-	-	-	-
Brewers grains[3]	-	22.4	27.4	-	23.0
Canned food[4]	-	5.0	10.0	-	10.0
Noodle[5]	-	5.0	10.0	-	-
Shepperd's pie	-	-	30.0	-	20.78
Cereal waste	-	-	-	32.4	-
Pogo	-	20.0	-	10.0	10.0
Pizza pockets	5.0	-	-	-	-
Tallow	3.5	-	-	-	-
Limestone	0.5	1.8	0.5	0.5	0.23
Dicalcium Phosphate	1.8	0.5	1.8	1.8	0.84
NaCl	0.2	0.2	0.2	0.2	.01
Vit/Min premix[5]	0.1	0.1	0.1	0.1	0.05
Total	100	100	100	100	100
Conventional ingredients	51.6	2.6	2.6	2.6	1.22
Waste %	48.4	97.4	97.4	97.4	98.78

[1]Bakery waste: 75 % bread and 25 % cookies.
[2]By product of tofu production.
[3]Barley.
[4]Baked beans and lentils.
[5]Mineral premix for ducks: Iron, 95 ppm (Ferrous sulfate, $FeSO_4$, 36.8% Fe); Zinc, 60 ppm (Zinc oxide, ZnO, 73 % Zn); Copper, 8 ppm (Cupric carbonate, basic $CuCO_3$ 55% Cu); Manganese, 60 ppm (Manganese oxide, MnO_2 55% Mn); Selenium, 0.2 ppm (Sodium selenite, Na_2Se_3O, 45.6% Se), Na_2SeO_3; Iodine, 0.4 ppm (Potassium iodide KI 76.4 % I) To be added at 0.05 % of the diet.
[5]Vitamin premix: vitamin A, 2,500 I.U.; vitamin D_3, 400 I.U.; vitamin E, 10 I.U.; vitamin K, 0.5 mg; biotin, 0.1 mg; folacin, 0.5 mg; niacin, 55.0 mg; pantothenic acid, 11.0 mg; riboflavin, 4.0 mg; thiamine, 2.0 mg; pyridoxine, 2.5 mg; vitamin B-12, 0.01 mg; ethoxyquin or BHT or Santoquin, 100.0 mg. To be added at 0.05 % of the diet.

Table 2.2: Proximate analysis of the commercial and experimental diets (dry matter)[1]

FEED	D.M. %	C.P %	E.E. %	G.E. kcal/kg	Ash %	Ca %	P %
Commercial:							
Starter	87.83	25.58	3.90	4570	6.03	1.02	0.72
Grower	86.89	23.34	3.63	4599	5.41	0.94	0.77
Finisher	87.30	21.33	5.51	4665	5.28	0.85	0.70
Mac mash feed	82.72	22.62	9.59	4513	6.46	1.11	0.90
Fruit and vegetable[2]	21.62	14.44	1.86	4372	4.79	0.27	0.26
wet mash 4	37.29	17.68	14.25	4846	5.11	0.75	0.68
wet mash 5	45.78	17.65	12.83	4732	4.42	0.68	0.62
dry mash 6	84.35	19.64	10.25	4651	5.79	1.09	0.68
wet mash 6	34.96	22.20	15.26	4972	5.56	0.82	0.76

[1]Crampton Nutrition laboratory, Macdonald Campus of McGill University.
[2] The fruit and vegetable mix varied greatly throughout the season.

Table 2.3: Proximate analysis of the wastes utilized in the experimental diets (dry matter basis).[1]

Waste product	D.M. %	Fat %	C.P. %	Ash %	G.E. Kcal/kg	ADF	Ca %	P %
Okara	24.34	14.95	33.12	3.77	5134	12.93	0.27	0.46
Shepherd's pie	37.01	22.45	40.65	5.55	5289	0.99	0.04	0.36
Baked beans	35.28	3.4	19.33	4.85	4134	10.79	0.17	0.33
Lentils	23.33	1.16	26.32	9.82	3878	6.83	0.05	0.25
Noodles	44.9	4.45	15.47	0.32	4521	0.34	0.02	0.11
Granola bars	88.36	9.6	6.51	1.31	4811	0.79	0.06	0.15
Cookies	84.92	3.49	11.47	1.34	4249	0	0.11	0.25
Bread	92.31	3.65	15.79	1.88	4387	1.01	0.02	0.17
Pizza pockets	57.21	17.18	22.16	3.13	5048	0.99	0.25	0.3
Pogo	56.04	22.95	19.95	5.18	5068	0.78	0.29	0.26
Mixed Vegetables	17.73	1.86	14.44	3.93	4372	8.04	0.27	0.26
Brewer's grains	30.14	5.92	19.43	4.22	4193	21.2	0.33	0.55
Peanut skins	87.80	18.3	13.88	2.25	4864	34.1	0.33	0.09

[1] Crampton Nutrition laboratory, Macdonald Campus of McGill University

Feed preparation and storage

One of the objectives of the experiment was to minimize the processing of the food waste. Therefore only mixing and chopping were carried out to reduce particle size and obtain a better mix. All the feed preparation was done at the Macdonald campus recycling pilot plant. Since some diets included food wastes high in moisture content, these feeds were prepared in batches, kept in a walk-in freezer in portions of various sizes and thawed 24 hours before feeding to the ducklings. Any food waste product received at the plant that was already moldy or suspected of contamination was discarded. The chopping of the vegetables and the other food waste products was done with a rotary blade chopper[6] reducing particle size to 0.5 cm. The vitamins and minerals were pre-mixed with a fraction of the complete diet (40 kg) in a Hobart mixer[7]. The complete experimental diets were mixed in 200 kg batches with a Davis precision horizontal mixer[8].

Water and litter management

The ducklings were provided water ad-libitum since it is known that ducks consume a quantity of water equal to 4-5 times their feed intake. Their droppings contain about 90% moisture and excessive water spillage further contributes to wet litter. Therefore a collecting pan (volume of 0.02 m^3) was located under the bell type waterer.

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[6]Model D, W.J. Fitzpatrick Company, Chicago, USA

[7]Model V1401 Hobart, Troy, Ohio, USA

[8]Serial 4040-53-67, Davis, Bonner Springs, Kansas, USA

The collecting pan was covered with a wire mesh of 0,47 m^2 for the ducks to stand on. The collecting pan was emptied on a daily basis. The wet shavings were removed daily to keep the litter reasonably dry.

Culling of ducks

Injured or seriously ill ducklings were killed by cervical dislocation. This method of euthanasia is allowed by the Canadian Council of Animal Care to relieve pain or suffering.

Sexing

The ducklings were sexed at 42 days of age and verified at 49 days of age based on the distinctively different and characteristic sounds of the voices of males and females. The females produce a characteristic loud quack-quack whereas the male vocalization is more a soft hiss-hiss sound.

Slaughtering

At market weight (49 d of age), all the ducks were sent to the Brome Lake Ducks Limited slaughter plant. They were commercialised by this company except for 48 selected dressed carcasses which were returned for further measurement of yield and composition. One male and one female were selected with a live body weight close to the pen average and identified as representatives of each pen for carcass analysis before the ducks were sent to the abattoir.

Sample analysis

A representative sample from each industrial food waste product collected and from each batch of experimental feed prepared was subjected to proximate analysis (dry matter, crude protein, fat, ash, gross energy, ADF, calcium and phosphorus). Each sample was freeze-dried[9] pending the laboratory analysis. Subsequently, a sub-sample was oven dried to determine the absolute dry matter content using a vacuum oven[10]. After having been finely ground, the samples were analyzed for crude protein using a nitrogen analysis system[11]; gross energy was measured using an adiabatic oxygen bomb calorimeter[12]; calcium content was determined by flame atomic absorption spectrophotometry[13] after wet ashing with HNO_3; ash content was determined by burning the sample in a muffle furnace[14]; phosphorus was determined by the alkalimeter ammonium molybdate method (AOAC, 1984) and the color intensity read on a UV/VIS spectrophotometer[15] at 400 nm; ADF was determined by the method Van Soest.

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[9]Virtis Freeze dryer #278341 Gardiner, New York, USA

[10]National appliance company

[11]Leco FP-428, Leco Corporation, Saint-Joseph, MI, USA

[12]Number 1241, Parr Instrument Company, Moline, Illinois, USA

[13]Model 2380, Perkin Elmer, Norwalk, CT 60521

[14]Model F-A1730, Sybron Thermolyne, Dubuque, Iowa, USA

[15]Model DU-20, Beckman, Fullerton, CA 92713

Statistical analysis

The data were analyzed using the General Linear Models procedure for analysis of variance (S.A.S. Institute, 1985) using the contrast between treatments. The model included the effects of the diet, block, and interaction. The design was factorial with 6 treatments, 2 blocks, and 2 replicates per treatment per block. The experimental treatments were contrasted with the control using F-test.

RESULTS

Mortality and culling

Throughout the experiment a total of 10 ducklings (1.7%) were lost due to mortality or culling. Of these, two died within the first 48 hours, and eight were culled because of leg problems. The losses occured randomly across experimental treatments.

Sex distribution

The flock of 600 ducklings was composed of 52% females and 48% males. The sex determination was conducted at 42 and 49 d of age, thus the distribution in the two blocks at 14 d of age was done without considering the sex, resulting in a distribution of 54% females in the light block and 46% in the heavy block; the reverse being true for the males.

Battery brooder vs floor brooding

Since this was the first flock of ducks raised here in many years, a comparison was made between ducklings started in battery brooders and those brooded in floor pens. Ducklings were weighed in groups of 10 for the battery cages and 25 for the floor pens at one day of age. The average duckling weighed 56 g and the weights were similar for all groups. After one wk of age, the average live weight of the ducklings in the batteries was 249.6 g compared to 255.6 g for the ducklings in the floor pens. At 14 d of age the ducklings in the floor pens had an average weight of 725.8 g, the ducklings moved from battery cages to floor pens at 7 d of age weighed 688,7gr. and the ducklings moved at 12 d of age weighed 698.7 g. Thus at 14 d of age the ducklings in the battery brooder were 32.3 g lighter than those started on the floor. The feed consumption per duckling at 14 d of age was 1082 g in floor pens and 1170 g in battery cages.

Temperature

The ambient temperature of the room after the brooding period of 14 d fluctuated due to the temperature outside. The temperature inside the building between June 09 and June 22(ducklings 0-14 d of age) was 30°C at all times and between June 23 and July 27, (ducks14-49 d of age) it ranged between a day time maximum of 32°C and a night time minimum of 16°C.

Feed consumption

Table 2.4 summarizes the average feed consumption (reported on a dry matter basis) per duckling during the 7-wk period for each treatment. This table also shows the form of feed, either dry or wet mash, that the ducklings consumed, both reported on a 100% dry matter basis. It shows that the ducklings of Treatments 4,5 and 6 preferred the wet mash in the proportion of 57-62% compared to the dry mash feed. Treatments 2 and 3 indicated that the ducklings did not favour the chopped vegetables, with a very low total consumption of 9 and 8% of their total intakes respectively.

Table 2.5 summarizes the average consumption per duck of the major nutrients by treatment during the entire 7-wk experimental period. Treatment 1 (control commercial pellet), consumed 342 g of fat while Treatment 4 consumed 891 g and Treatment 6 consumed 941 g of fat, almost 3 times the quantity eaten by the ducks of Treatment 1. This wide variation of fat consumed affected the gross energy intake and the crude protein:fat ratio consumed in the different treatments. The calcium and phosphorus intake varied somewhat among treatments, however the calcium: phosphorus ratio was close and ranged from 1.18 for Treatment 4 to 1.25 for Treatments 2,3 and 6. Table 2.6 summarizes the average feed consumption per duck by treatment according to the changing phases of the commercial feed program. These changes in feed correspond to the starting phase (0-14 d), growing phase (14-28 d) and the finishing phase (28-49 d). Treatment 1 consumed the lowest amount of feed (7.159 kg) on a dry matter basis and treatment 3 consumed the most (8.323 kg). The ducks in all the other treatments ate similar amounts of feed, around 7,500 kg.

Table 2.4: Average feed consumption per duck by treatment in the form of dry feed or wet mash and the respective preference for each in parenthesis (dry matter basis).

Treatment	Dry feed[1] (kg)	Wet mash or vegetable (kg)	Total D.M. Consumption (kg)
1 control (pellet)	7.159 (100)[2]	0 (0)[2]	7.159
2 control + chop veg.	7.025 (91)	0.727 (9)	7.586
3 Mac + chop veg.	7.649 (92)	0.674 (8)	8.323
4 Mac + wet 4	2.947 (39)	4.664 (61)	7.611
5 Mac + wet 5	3.134 (43)	4.024 (57)	7.158
6 Dry 100% waste + wet 6	2.884 (38)	4.642 (62)	7.526

[1]Treatments 3,4,5, and 6 in mash form and the starter feed consumed was included in the dry feed.
[2]In parenthesis is the percentage of total consumption

Treatment 1 vs Treatment 2 $p < 0.0733$
Treatment 1 vs Treatment 3 $p < 0.0182$
Treatment 1 vs Treatment 4 $p < 0.0448$
Treatment 1 vs Treatment 5 $p < 0.3640$
Treatment 1 vs Treatment 6 $p < 0.0137$

Table 2.5: Average consumption of the proximate principles per duck by treatment based on total feed consumption (expressed on DM Basis)

Treatment	DM kg	C.P kg	Fat g	C.P./fat	G.E Kcal	Ca g	P g	Ca/P
1 control (pellet)	7.159	1.067	342	4.70	33,156	64	52	1.23
2 control + veg	7.752	1.684	351	4.80	35,728	65	52	1.25
3 Mac + veg	8.323	1.856	691	2.69	37,522	86	69	1.25
4 Mac + wet 4	7.611	1.522	891	1.71	35,958	67	57	1.18
5 Mac + wet 5	7.258	1.440	686	2.10	33,243	62	52	1.19
6 Dry 100% waste + wet 6	7.526	1.656	941	1.76	36,413	69	55	1.25

Table 2.6: Average feed consumption per duck by age period and average feed conversion to 49 d on dry matter basis

Treatment	0-14d g	14-28d g	28-49d g	0-49d g	Feed/Gain
1 control (pellet)	967	1964	4228	7159	2.28 ± 0.02
2 control + chop veg.	993	2001	4426	7586	2.46 ± 0.02
3 Mac + chop veg	962	2037	5324	8323	2.52 ± 0.02
4 Mac + wet 4	995	2205	4411	7611	2.34 ± 0.02
5Mac + wet 5	991	2110	4157	7258	2.40 ± 0.02
6 Dry 100% waste + wet 6	980	2280	4266	7526	2.40 ± 0.02
AVG	981	2100	4469	7577	2.41 ± 0.02

Treatment 1 vs Treatment 2 $p<0.0003$
Treatment 1 vs Treatment 3 $p<0.0001$
Treatment 1 vs Treatment 4 $p<0.1370$
Treatment 1 vs Treatment 6 $p<0.0002$
Treatment 4 vs Treatment 6 $p<0.0039$

Feed conversion between block $p<0.0722$

Feed conversion

The mean feed conversion for each treatment from 1 to 49 d of age and on a dry matter basis are reported in Table 2.6. Treatment 1 (control) had the best feed conversion but there was no statistical difference between Treatments 1 and 4 ($P = 0.14$). There was a statistically significant ($p < 0.05$) difference between each of the other treatments and the control. There was no significant difference ($P = 0.07$) in feed conversion between the light and heavy blocks but there was a tendency for the heavy block ducks to be more efficient than those in the light block.

The average 49d body weights of the ducklings for the heavy and light blocks are shown in Table 2.7. The block separated as heavy at 14 d of age showed a significantly heavier body weight at 49 d of age ($P < 0.01$) when compared to the light block. The same result was apparent for the average daily gain. The ducklings in the heavy block were on average 145 g heavier than those in the light block and gained 3,0 g per d more than the light block. The average body weight for male and female ducklings is shown in Table 2.8. The males were heavier ($P < 0.001$) than the females and had a greater average daily gain ($P < 0.001$). There was no interaction between sex and block, ($P = 0.91$). Table 2.9 summarizes the final average body weight and the average daily gain of the ducks by dietary treatment from day old to 49 d of age. The contrasts indicated that there were no statistically significant differences for these parameters of production at 49 d of age ($P > 0.05$), but there was a tendency for Treatment 3 to be poorer than Treatment 1 ($P < 0,08$). Tables 2.10 and 2.11 summarize for the heavy and light blocks, respectively, the average body weights of the ducklings at 14, 28 and 49 d of age by treatment and sex.

Table 2.7: Average body weight of the ducks by block at 49 d of age and average daily gain during the 49 d of the experimental period.

Block	Body Weight[1]	AVG daily gain [1]
	g	g/d
Light	3,102 ± 35[b]	62.16 ± 0.72[b]
Heavy	3,247 ± 34[a]	65.12 ± 0.70[a]
AVG	3,174 ± 35	63.64 ± 0.71
p value	0.01	0.01

[1]Mean ± SEM
[a,b]Means within a column with different superscripts differ significantly.

Table 2.8: Average body weight of the ducks by sex at 49 d of age and average daily gain during the 49 d of the experimental period.

Sex	Body weight[1]	AVG daily gain[1] mean ± SEM
	g	g
Female	3,072 ± 34[b]	61.55 ± 0.70[b]
Male	3,277 ± 36[a]	65.74 ± 0.73[a]
AVG	3,174 ± 35	63.64 ± 0.72
p value	0.001	0.001

[1]Mean ± SEM
[a,b] Means within a column with different superscripts differ significantly.

Table 2.9: Effect of dietary treatment on average body weight at 49 d of age and average daily gain during the 49 d of the experiment.

Treatment	LSMean ± S.E.M.	
	Body weight[1]	AVG daily gain[1]
	g	g/d
1 control (pellet)	3,192 ± 61	64.01 ± 1.25
2 control + chop veg.	3,151 ± 60	63.66 ± 1.21
3 Mac + chop veg	3,031 ± 60	60.72 ± 1.22
4 Mac + wet 4	3,321 ± 60	66.62 ± 1.25
5Mac + wet 5	3,128 ± 61	62.69 ± 1.25
6 Dry 100% waste + wet 6	3,224 ± 60	64.66 ± 1.22
AVG	3,174 ± 60	63.55 ± 1.23

[1] Mean ± SEM

Contrast body weight
- 1 vs 2 p < 0.6356
- 1 vs 3 p< 0.0839
- 1 vs 4 p< 0.1661
- 1 vs 6 p< 0.7186
- 4 vs 6 p< 0.2829

Contrast AVG daily gain
- 1 vs 2 p< 0.6353
- 1 vs 3 p< 0.0839
- 1 vs 4 p< 0.1663
- 1 vs 6 p< 0.7187
- 4 vs 6 p< 0.2831

Table 2.10: Average body weight at different ages by treatment and sex for the light block.

Treatment	Sex	Body weight at age		
		14 d	28 d	49 d
		g	g	g
1 control (pellet)	F (27)[1]	669	1,736	3,058
	M (18)[1]	676	1,783	3,274
2 control + chop veg.	F (25)[1]	668	1,697	2,902
	M (23)[1]	684	1,781	3,183
3 Mac + chop veg	F (19)[1]	680	1,592	2,742
	M (28)[1]	658	1,573	3,030
4 Mac + wet 4	F (34)[1]	663	1,612	3,091
	M (16)[1]	665	1,650	3,154
5 Mac + wet 5	F (28)[1]	654	1,622	3,169
	M (21)[1]	647	1,630	3,283
6 Dry 100 % waste + wet 6	F (26)[1]	657	1,629	3,058
	M (18)[1]	665	1,658	3,248
AVG	F (159)[1]	665	1,648	3,003
AVG	M (124)[1]	666	1,679	3,195

[1]Number of birds

Table 2.11: Average body weight at different ages by treatment and sex for the heavy block.

Treatment	Sex	Body weight at age		
		14 d	28 d	49 d
		g	g	g
1 control (pellet)	F (24)[1]	773	1,836	3,089
	M (24)[1]	776	1,864	3,200
2 control + chop veg	F (27)[1]	742	1,867	3,135
	M (24)[1]	752	1,846	3,540
3 Mac + chop veg	F (28)[1]	741	1,717	3,099
	M (23)[1]	759	1,772	3,256
4 Mac + wet 4	F (20)	740	1,774	3,398
	M(29)[1]	766	1,836	3,611
5 Mac + wet 5	F(21)[1]	761	1,641	2,911
	M(25)[1]	763	1,690	3,145
6 Dry 100 % waste + wet 6	F(21)[1]	764	1,834	3,249
	M(28)[1]	765	1,806	3,344
AVG	F (141)[1]	754	1,778	3,147
AVG	M (157)[1]	464	1,802	3,349

[1]Number of birds

DISCUSSION

Battery vs floor pen

Starting the day-old ducklings in battery brooders to simulate a wire mesh floor like the one utilized in the industry did not show any advantage over floor pens. In fact, at 14 d of age the ducklings started in cages were 32 g lighter than those placed directly in floor pens. Considering that it also required extra manipulation and that the ducklings appeared to waste more feed in the battery brooders, this practice was avoided for the subsequent flock. A personal communication from Mr. Claude Trottier, General Manager at Brome Lake Ducks Limited, indicated that they are raising ducklings on mesh floors to reduce space and management requirements for the first 14 d of rearing but without knowing the difference in feed conversion that exists between ducklings reared on wire mesh floors or wood shavings litter in a commercial unit. They do not know the amount of feed lost due to spillage. It was observed with ducklings in batteries, that when feed fell through the wire mesh it was not recoverable by the ducklings whereas in the floor pens, some of the spilled feed can be recovered by the ducklings.

Dry and wet mash feed

The choice of feeding the commercial starter for all the ducklings for the first 14 d was to make sure that all the ducklings had a good start. The choice of feeding dry and wet mash feed or chopped vegetables on a cafeteria basis for treatments 3,4,5 and 6 was to make sure that the ducklings consumed enough dry matter to grow at their maximum rate. Numerous studies have demonstrated marked improvements in weight gain and feed conversion when pellets are fed in place of mash feed. Heuser and Scott, (1951) using Pekin ducklings, observed that ducklings receiving both dry and wet mash feed grew at approximately the same relative rate compared to the ducklings receiving pelleted feed at 4 to 9 wk of age. However the pellet fed ducklings were the heaviest at the end of the experiment. This was not the case in the present study because treatment 4 (Mac mash dry feed and wet feed) resulted in the heaviest ducklings at 49 d of age followed by treatment 6 (Table 2.9), in which the ducklings also consumed more wet feed than dry feed. The difference between the study reported here and that of Heuser and Scott (1951) used the same feed or ration and changed only the form of the feed. Wilson (1973) found no difference in live-weight when White Pekin ducklings were fed either mash, crumbles or pellet feed. Ducks will prefer pellets to dry mash feed when given a choice (Scott and Dean, 1991). The structures of the duck's bill which allow efficient straining of submerged food material or of dry food material of an appropriate size are not well designed for the consumption of mixed feeds in the dry mash form. Therefore prior to adopting pelleted feeds in commercial operation (about 1941) it was common practice for Long Island duck farmers to give ducklings wet mash feed twice daily (Scott and Dean 1991). It explained the high consumption of wet mash feed (about 60%) compared to the dry mash consumption (40% including the first 14 days of crumbled starter) for treatments 4, 5 and 6. This may explain the poor performance of Treatment 3 receiving the dry mash Mac feed and chopped vegetables. We observed that to facilitate the swallowing of the dry mash feed, these ducklings were going back and forth between the feeder and the waterer. Considerable feed was wasted in the water and around the water bell in the litter. This behaviour was apparent in all treatments but not as much as in treatment 3. These observations on the loss of feed explain the higher feed consumed by that treatment and its poor feed conversion. Wilson (1973), also observed that treatments receiving mash feed had a higher feed consumption ($P<0.001$). In their case the extent to which that greater spillage contributed to the poorer feed conversion associated with the mash form was not possible to assess due to the water system utilized, a continuous trough serving all the pens. In the study reported here, it was almost impossible to assess the feed spillage because some feed was found in the water bell, some in the collecting pan and some feed in the litter. In the past, wetting the mash feed made possible a much greater rate of feed consumption, however this method of feeding is very labour intensive, as was experienced here, and feed mixed too far in advance or left in troughs often becomes moldy (Scott and Dean, 1991). The problem of moldiness was avoided by keeping the feed mixed in advance in a freezer and thawing only what was required on a daily basis. Also, since it was only a small flock it was relatively easy to feed the wet mash in an estimated quantity ad-libitum but making sure that a minimum of feed was left over before the next feeding.

Distribution of ducklings in blocks

The distribution of the ducklings at 14 d of age was based on the average body weights of the birds at that time. The average was 665 grams for the light block and 754 grams for the heavy block and 709 grams for the over all average. At that point it seemed that some ducklings expressed their superior genetic potential for fast growth. The light block was 12% lighter than the heavy block. This difference decreased by about 2% per week to reach an equilibrium of 6% difference at 42 and 49 d of age. The sex distribution determined later on showed that males and females were fairly evenly distributed, 54% of the females and 46% males in the light block and the reverse in the heavy block.

Until 14 d of age all the ducklings received the same feed, the commercial starter diet. Thus the remaining 35 d of rearing determined the efficiency and effect of each dietary treatment. Ranked by body weight from d 21 to d 42, the heaviest treatment to the lightest was: Treatments 1,2,6 or 4, 3 and 5. At 49 d of age, the ranking was 4,1,6,2,5 and 3. Based on these changes, we can assume that the nutrient content of treatment 4 was more suitable for the last 7 d of growth. Treatment 6 containing only waste, held the same rank throughout the experiment. Treatment 2 slipped off a few positions (2nd to 4th) during the last 7 d. The consumption of chopped fresh vegetables by the ducks in this treatment was higher during the last 14 days of the experiment which may have diluted the energy and protein contents of the commercial pelleted feed due to the higher fibre content of the vegetable mix. Treatment 3 was the poorest from beginning to end even though it showed the greatest consumption. Part of that consumption most likely was lost as explained previously. When we look in Table 2.2 for the composition of each diet reported on a 100% dry matter basis, the Mac feed is comparable to the commercial grower and finisher and it should not have resulted in a large difference in growth performance.

Performances

In Table 2.6 it can be seen that the ducklings receiving only crumbled and pelleted feed had the best feed conversion, however when we contrast that result to the one obtained with Treatment 4 there is no difference ($P<0.14$). Heuser and Scott (1951) obtained a better feed conversion when ducklings received the same diet as pellets rather than as dry mash or wet mash or dry mash and wet mash fed together. In the current study, all treatments were different from each other; the ducks in Treatment 4 consumed more than those in Treatment 1 but they had a higher body weight at 49 d and the same feed conversion since no significant difference was observed ($P<0.14$). We also observed no statistically significant difference between the light block and heavy block ($P<0.07$) but there was a tendency for the heavy block birds to eat more, to have a higher body weight and to be more efficient than the light block birds. Treatment 5, in the light block performed better than same treatment in the heavy block. At 14 d of age the light group of Treatment 5 was like all others in the light group, about 12% lighter than the heavy group. At 49 d of age Treatment 5 in the light group was 6% heavier than the heavy group and that can be explained by the higher feed consumed by the ducklings in this particular light group. In fact, these ducklings ate 6% more feed than those in the heavy block. The 6% higher feed intake is probably not the only reason for the 6% higher body weight at 49 d of age, but most of the increase in feed consumption occurred during the last 14 d of the experiment. Examination of the diet composition

(Table 2.2) reveals the fact that the ducklings in the light block by increasing their feed intake, also increased their consumption of fat and energy compared to the heavy block. The higher consumption of energy can explain part of the greater body weight gain. When we look at the pen record sheet we also notice a reduction of feed consumption by the heavy block birds for no known reason. The utilization of choppped fresh vegetables was not conclusive in this study, no improvement in feed conversion was noticed. The benefit of using chopped vegetables was mainly to reduce the consumption of feed and the fact that it costs nothing to obtain (handling, transport and storage not considered). Zia-ur-rehman et al. (1994) observed an improvement in egg production and egg size when rice polishings in a ration for laying hens were replaced by 8% dried carrot residue. The increase in performance however, was thought to be more related to the higher feed intake by the hens receiving the carrot residue. The laying hens in that study consumed significantly ($P<0.05$) more feed and laid significantly ($P<0.01$) more eggs. Squires et al. (1992), used untreated tomato pomace as received from the manufacturer at 10 and 20% in broiler chick diets. They found that chicks receiving 10% tomato pomace performed as well as those fed the control diet. One of the concerns of these authors was a report by the NRC (1971) that tomato cannery waste has the potential to be a good protein source but may be limiting in energy due to its high fibre content. In this present study, the vegetables fed were a mix of vegetables. The mix was subjected to seasonal variation, therefore, carrots, tomatoes, sweet corn, lettuce and green pepper were utilised.

The utilization of brewer's grain in feed is not new, particularly in feed for dairy and beef cattle. Pfaff et al (1990), added 30 and 45% dried brewer's grains in diets to Chinese Ringneck pheasant breeder hens and found it had no effect on fertility or egg production compared to the control. However, the birds fed brewer's grains consumed more feed ($P<0.01$) when compared to the control in order to maintain an equivalent consumption of metabolizable energy. Since those birds consumed more to meet their energy requirement due to the higher fibre content it can be assumed that ducklings will do the same. Due to their low price brewer's grains are a good alternative source of protein and energy when bought directly from the brewing companies and utilized without drying. Table 2.5 lists the consumption of the proximate principles per duck in each treatment. The crude protein-metabolisable energy ratio will be a more suitable parameter to evaluate the effect of that diet on the carcass composition. Since the waste products are unusual feedstuffs, metabolic studies in the future will be required to determine the metabolizable energy content and to use the food waste more judiciously. Therefore the utilization of the crude protein-fat ratio in the present experiment is more appropriate.

CONCLUSION

The inclusion of unconventional food waste in balanced diets has not been utilized by many researchers or producers. Most waste utilizers include a very limited amount of food waste in their diets. Many feed manufacturers recognize the potential of these food wastes, few are ready to be involved in increasing the value of these products by utilizing them more or to organize a transforming facility or a collecting centre. Many producers are using food waste as a supplement to their animals without regard for nutrient balance. Some producers utilize waste in a more rational way by working with agrologists and nutritionists to achieve more rational incorporation of food waste in the complete diet. This experiment successfully demonstrated that utilization of food waste as an alternative to grain and other conventional ingredients is feasible with White Pekin ducklings. Thus, because of the quantity available and the low or no cost of industrial food waste it should provide a good economical and environmentally friendly way to produce ducklings or other farm animal species in a sustainable agriculture in Quebec.

SECTION III

GROWTH TRIAL 2

The objective of this study was to evaluate the recycling of industrial food wastes into feed for the production of Pekin ducks.

ABSTRACT

Duck Meat Production Using Agro Industrial Waste in the Province of Quebec.

The goal of this study was to demonstrate the feasibility of using industrial food wastes as a feed resource in the production of duck meat. An inventory in the Montreal region was performed to identify the industrial wastes to be used in the study. Some of the food industries interested in the project were selected and their wastes sampled and analyzed. Six hundred unsexed day-old Pekin ducklings were used in this study. The ducklings distributed at random in groups of 25 per pen received the experimental diets at 1 day of age. The experimental design included 2 blocks, each with 6 treatments and 4 replicate pens per treatment. The feed and water were provided ad libitum throughout the experiment. The ducklings in the control (T1) received commercial pelleted feeds as follows: 14 days starter 25.58% crude protein, (C.P.) on a dry mater basis (DMB); 14 days grower (23.34% C.P., DMB) and 21 days finisher (21.33% C.P., DMB). Duckings in Treatments 2, 3, 4, and 5 received a mash starter for 21 days (24.43%C.P., DMB). Starting at 14 days of age Treatments 2, 3, 4, and 5 received a wet mash feed and the dry mash feed. Treatment 2 received a mix of chopped vegetables and okara which contained 29.03% dry matter (DM) and 24.24% C.P. DMB. Treatments 3, 4 and 5 received a different wet mash feed with the same ingredients but in differing proportions. Treatment 3 received a wet mash feed containing 56.54% DM, 18.09% C.P. DMB Treatment 4 contained 42.95% DM, 18.11% C.P. DMB. Treatment 5 received the wet mash feed containing 58.81% (18.77 % CP DMB). Treatment 6 was a treatment using only food waste. The ducklings received the experimental starter in a

mash form for 14 days and a special dry mash feed composed of only waste (19.64 C.P. DMB) for 35 days and at 14 days of age they also received a wet mash feed containing 54.89% DM (21.65% C.P. DMB). A vitamin and mineral premix was formulated to supplement these diets. Feed consumption was recorded weekly and calculated on a dry matter basis. Individual body weights were recorded at 14, 21, 35 and 49 days of age. The feed conversion data demonstrate that Treatments 3 and 6 were significantly better than the control ($P<0.01$). However, Treatment 1 was significantly better ($P<0.01$) than Treatments 2 and 4. Treatments 3, 4 and 6 showed significatly heavier body weights ($P<0.01$) when compared to Treatment 1 (control). These results demonstrate that it is feasible to raise Pekin ducklings for meat in a commercial way using industrial food wastes. In consequence, it will be possible to reduce the volume of wastes lost in the environment. This recycling of industrial food waste into animal production will reduce the feed cost of production as well as reducing the environmental pollution impact of these organic wastes when disposed in landfill.

INTRODUCTION

Expansion of livestock production puts pressure on the world supply of grain since livestock are in direct competition with humans for its consumption. Thus the utilization rather than the disposal of wastes emerging from food processing factories provides a solution for sparing some grains for humans. The transformation of these wastes into a material of added value such as duck meat will provide an alternative means of reducing disposal problems as well as providing new feed resources for production. The objective behind recycling food waste into animal product is to achieve the same level of performance while decreasing the cost of production and attaining a more sustainable agriculture system. Some nutritionists involved in the utilization of food waste by-products consider that inclusion at more than 70-75% of the ration is not recommended (Lachance, 1996). However, the advantages and incentives of using food waste by-products depend on the price of the basic ingredients such as cereals and soybeans. The utilization of more than 70-75% is not recommended at least in swine, because the producer is more exposed to increased mortality and loss of performance (Lachance, 1996). This seems to indicate that the information on the nutritional composition of the alternative feedstuffs is incomplete, often unavailable and highly variable due to the method of processing. Under these conditions it becomes difficult to formulate diets to guarantee an optimum nutritional balance and maximum performance. Research is therefore required to increase our knowledge in order to maximize the utilization of industrial food wastes by producers and the feed industry.

The first experiment performed at the Macdonald Campus using industrial food wastes after 14 days of age demonstrated that it is possible to produce ducklings at a market weight of 3.2 kg in 49 days without negatively affecting performance by using food wastes. This second experiment was designed to utilize food waste from one day of age in a variety of formulations and to maximize their incorporation in duck diets. In fact ducklings received industrial food wastes from day-old to market weight. In this study the starter and finisher dry diets were formulated to include 50% conventional and 50% unconventional feedstuffs. They were offered free-choice with a wet mash feeds formulated with different combinations of food wastes providing 97 or 98%of the ingredients. The results of the first experiment suggest that it is possible to use more than 75% food wastes in the diet of ducklings without affecting the performance or mortality. The goal of this experiment was to improve the formulation of the first experiment by using a different combination of food wastes and to maximize their inclusion in the diet.

MATERIALS AND METHODS

Animals

Six hundred unsexed day-old White Pekin ducklings were purchased from a private hatchery[16]. Upon arrival all the ducklings were weighed in groups of 25 and placed at random in 12 floor pens (3,03 m * 1,85 m) with soft wood shavings litter.

[16]Brome Lake Ducks Limited, Knowlton, Qc, Canada, JOE 1VO

The ducklings were confined in a carboard ring (45 cm height) with a bell type waterer and a tube feeder. An egg tray was also provided for extra space for feed for 3 days and some grit was also supplied during that time since the ducklings showed a tendency to eat shavings. Extra heat was supplied by a heat lamp (red). The ambient temperature in the building was maintained at 30^0 C and 32^0 C under the heat lamp at floor level. The heat lamp was removed 14 d later. The cardboard rings were removed after 4 d, allowing the ducklings access to the whole pen. For the first 14 d, the ducklings received 23 hours of light and 1 hour of darkness but some light was provided by the heat lamp. After removal of the heat lamp the lighting program was 6 hours of darkness and 18 hours of light from 4:00 AM to 10:00 PM. The light intensity was gradually reduced as the growing period advanced. The ducklings were wing-banded and weighed individually at 14 d of age. They had access to water and feed ad-libitum throughout the experiment. Feed consumption was recorded on a weekly basis and reported on a dry matter basis due to the difference in dry matter contents of the feeds. Individual body weights were obtained at 14, 21, 35 and 49 days of age.

Experimental design

Six hundred ducklings were randomly distributed in six different dietary treatments at day-old and 10 extra ducklings were kept separately to serve as replacements in case of early mortality. At 14 d of age the ducklings were distributed randomly into 2 different blocks (light and heavy) according to the average body weight within each treatment. For each treatment we had 100 ducklings distributed into 2 different blocks with 2 replicate pens per block and 25 ducklings per pen.

Building facilities

All the ducklings were kept at the Poultry Unit located at the Macdonald Campus of McGill University, in a windowless, fan-ventillated poultry house. The room with the floor pens had 4 exhaust fans of 45 cm in diameter and 2 big fan of 80 cm in diameter hung up on the ceiling to insure the movement of the air in the building. Two doors at the entrance and one at the other end which communicates with the outside were kept open after the first 14 days of age to allow more fresh air from the outside to come inside the room.

Treatment

Six different dietary treatments were utilized for this experiment. The feed was offered to the ducklings in 2 forms, dry mash feed or wet mash feed except for the control which received only commercial pelleted feed[17] as starter, grower or finisher. The treatments involving the dry mash and the wet mash feeds were supplied in different feeders ad libitum, the ducks having the choice of eating what they preferred. The ducklings in Treatment 1 received 14 d of crumbled starter, 14 d of pelleted grower and 21 d of pelleted finisher. Treatment 2 ducklings received 21 d of mash starter, 28 d of mash finisher prepared at the Macdonald Campus, and starting at 14 d of age they received a mix of chopped vegetables, okara and vitamin-mineral premix. The starter and

[17]Meunerie Shur-Gain CPL, L'Ange Gardien, Québec

finisher specially formulated to corespond to the commercial feed was named Mac starter and Mac finisher was used for the dry mash feed. This feed was formulated to contain about 50% conventional feedstuffs and 50% unconventional feedstuffs. Treatments 3, 4 and 5 ducklings also received 21 d of Mac starter and 28 d of Mac finisher and they received starter at 14 d of age a wet mash designed to contain 18% CP (DMB) by utilizing various combinations of food wastes. Treatment 6 ducklings received 14 d of Mac starter and 35 d of a dry mash formulated to contain only wastes and a wet mash feed, also with food wastes. The Mac starter was formulated to contain 22% CP, the Mac finisher, 18% CP, and the dry mash for Treatment 6, 12% CP. The known crude protein and dry matter contents of the food wastes were utilized to formulate the diets since the metabolizable energy for ducks is not available for such unconventional feedstuffs. The vitamin and mineral supplements were added based on the dry matter content of each diet and they were added to meet or exceed the NRC (1994) nutrient requirements for ducks.

The compositions of the experimental diets are described in Table 3.1 except for Treatment 2 in which the ducklings received a mix of chopped vegetables, okara and vitamin-mineral supplements. The chemical analyses of the experimental diets using the average of the different batches prepared during the experimental period and analysed separately are reported on a dry matter basis in Table 3.2. Table 3.2 gives the chemical analyses also reported on dry matter basis of the different food wastes utilized for the experiment.

Feed and feeding management

The ducklings were fed ad libitum throughout the experiment. The ducklings of treatments 2,3,4,5 and 6 received experimental diet Mac starter at 1 day old. At 14 d of age, all treatment groups except the control had free access to a dry mash feed and a wet mash feed. The feed was added on a daily basis especially the wet feed to avoid the danger of fermentation or mold growth. Any wet feed left in the feeder for more than 48 hours was discarded. The dry mash or pelleted feed was provided in a hanging tube feeder (capacity of 0.56 m^3) and the wet feed in an open trough with a capacity of 0.018 m^3.

Table 3.1: Composition of the Experimental Diets

Ingredient	Mac Starter	Mac Fin	Wet 3	Wet 4	Wet 5	Dry 6	Wet 6
	%						
Granola	10.6	18.0	10.0	10.0	17.2	13.0	17.44
Bakery waste[a]	18.0	16.4	10.0	-	15.0	35.0	15.0
Okara	3.0	5.0	14.33	35.0	17.0	-	-
Brewers grain[b]	-	-	15.0	22.4	10.0	-	11.0
Peanut skin	2.0	2.5	-	-	2.0	7.0	-
Pogo meat	3.0	8.5	25.0	-	-	-	25.0
Pogo	3.0	-	14.0	20.0	-	10.0	-
Peanut	3.0	2.0	-	-	2.0	-	-
Noodle	-	-	10.0	5.0	15.0	-	-
Canned food[c]	-	-	-	5.0	-	-	10.0
Tofu	-	-	-	-	20.0	-	20.0
Cereal waste	-	-	-	-	-	32.4	-
Corn	12.0	10	-	-	-	-	-
Barley	10.3	7.8	-	-	-	-	-
Soybean meal	22.0	16.5	-	-	-	-	-
Wheat bran	2.5	2.0	-	-	-	-	-
Alfalfa meal	-	2.5	-	-	-	-	-
Fishmeal[d]	4.0	3.0	-	-	-	-	-
Tallow[d]	4.0	3.5	-	-	-	-	-
$CaCO_3$	0.5	0.5	0.32	0.5	0.35	0.5	0.3
Ca_2HPO_4	1.8	1.5	1.16	1.8	1.26	1.8	0.3
NaCl	0.2	0.2	0.13	0.2	0.12	0.2	0.12
Vit and Min[e]	0.1	0.1	0.06	0.1	0.07	0.1	0.06
Total	100	100	100	100	100	100	100
% conventional feed + vit and min	57.4	47.6	1.67	2.6	1.8	2.6	1.56
% Waste	42.6	52.4	98.33	97.4	98.20	97.4	98.44

[a]Bakery waste composed of 25 % cookies and 75 % bread
[b]Brewers grain is barley
[c]Canned food include baked beans and lentils
[d]Fish meal and Tallow considered as conventional feedstuffs even if they are recycled products
[e]Mineral premix for ducks: Iron, 95 ppm (Ferrous sulfate, 36.8% Fe) $FeSO_4$ dry powder; Zinc, 60 ppm (Zinc oxide, 73 % Zn) ZnO; Copper, 8 ppm (Cupric carbonate, basic $CuCO_3$ 55% Cu); Manganese, 60 ppm (Manganese oxide MnO_2 55% Mn); Selenium, 0.2 ppm (Sodium selenite 45.6% Se), Na_2SeO_3; Iodine, 0.4 ppm (Potassium iodide KI 76.4 % I) to be added at 0.05 % of the diet.
Vitamin premix: vitamin A, 2,500 I.U.; vitamin D_3, 400 I.U.; vitamin E, 10 I.U.; vitamin K, 0.5 mg; biotin, 0.1 mg; folacin, 0.5 mg; niacin, 55.0 mg; pantothenic acid, 11.0 mg; riboflavin, 4.0 mg; thiamine, 2.0 mg; thiamine-HCl; pyridoxine, 2.5 mg; vitamin B-12, 0.01 mg; ethoxyquin or BHT or Santoquin, 100.0 mg. To be added at 0.05 % of the diet.

Table 3.2: **Proximate composition of the wastes utilized in the experiment expressed on a dry matter basis**

Waste product	DM %	Fat %	C.P. %	Ash %	G.E. Kcal/Kg	ADF	Ca %	P %%
Tofu	35.64	27.21	61.58	3.96	6,267	1.21	0.29	0.89
Shepperd's pie	37.01	22.45	40.65	5.55	5,289	0.99	0.04	0.36
Okara	23.29	12.73	32.89	3.84	5,.468	15.71	0.28	0.50
Lentils	23.33	1.16	26.32	9.82	3,878	6.83	0.05	0.25
Brewers grain[a]	30.14	5.92	19.43	4.22	4,193	21.20	0.33	0.55
Pogo meat	58.83	49.65	28.03	7.01	4,870	0.79	0.39	0.47
Pogo	56.04	22.95	19.95	5.18	5,068	0.78	0.29	0.26
Peanut skin	87.8	9.21	18.88	2.25	4864	34.1	0,33	0,09
Peanut	95.61	52.7	28.58	2.72	6634	13.1	0,04	0,27
Bread	89.31	3.65	15.79	1.88	4,387	1.01	0.02	0.17
Noodle	44.90	4.45	15.47	0.32	4521	0.34	0.02	0.11
Cookies	84.92	3.49	11.47	1.34	4,249	0	0.11	0.25
Granola	88.36	9.60	6.51	1.31	4,811	0.79	0.06	0.14
Mixed veg.	17.73	1.86	14.44	3.93	4,372	80.4	0.27	0.26

[a] Is composed of barley

Table 3.3: Proximate composition of the commercial and experimental diets expressed on a dry matter basis[1]

Feed	DM %	C.P. %	E.E. %	G.E. Kcal/Kg	Ash %	Ca %	P %
Starter pellet	87.83	25.58	3.9	4,570	6.03	1.02	0.72
Grower pellet	86.89	23.34	3.63	4,599	5.41	0.94	0.77
Finisher pellet	87.30	21.33	5.51	4,665	5.28	0.85	0.70
Mac starter[3]	83.92	24.43	11.50	5,111	7.59	0.91	0.94
Mac Finisher[3]	80.76	22.68	12.34	4,796	7.63	0.97	0.77
Vegetable Mix[23]	29.03	24.24	9.69	5,479	9.47	1.27	0.94
Wet mash 3[3]	56.54	18.09	19.16	5,229	6.43	0.80	0.69
Wet mash 4[3]	42.95	18.11	15.01	5,068	6.50	0.81	0.69
Wet mash 5[3]	58.81	18.77	12.24	5,053	4.76	0.69	0.65
Dry mash 6[3]	84.35	19.64	10.25	4,651	5.79	1.09	0.68
Wet mash 6[3]	54.89	21.65	20.24	5,229	5.87	0.73	0.70

[1]Analyses conducted at the Crampton Nutrition laboratory, Macdonald Campus of McGill University.
[2]Vegetable mix includes Okara and vegetables in equal proportion.
[3]Vitamins and minerals added based on the dry matter.

Feed preparation and storage

As in the first experiment, minimal transformation was practiced and only chopping and mixing were employed in diet preparation. All the feed was prepared at the Macdonald Campus Recycling Pilot Plant[18]. All the feed were prepared in advance since the data of the first experiment provided estimates of the amount of feed required per duck. Since all the feed was prepared in advance all diets were stored in a walk-in freezer at the Poultry Unit. The feed was thawed 24-48 hours before being fed. The chopping of the vegetables and the wastes was done with a rotary blade chopper[19] and screen reducing the particle size to 0.5 cm. The vitamins and minerals were mixed with a part of the complete diet (40 kg) in a Hobart mixer[20]. The complete diets were mixed in 200 kg batches with a Davis precision horizontal mixer[21].

Water and litter management

The ducks had free access to water throughout the experiment. Excessive water spillage and wet droppings (90% moisture) contributed to a wet litter. Therefore, the wet shavings were removed daily to keep the litter and the ducks as dry as possible.

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[18]21,111 Lakeshore Road, Sainte-Anne-de-Bellevue, Québec, Canada

[19]Model D, W.J. Fitzpatrick Company, Chicago, USA

[20]Model V1401 Hobart, Troy, Ohio, USA

[21]Serial 4040-53-67, Davis, Bonner Spring, Kansas, USA

Culling of ducks*

During the course of the study, several ducks were removed because of leg problems. The ducks were killed by cervical dislocation, a method of euthanasia sanctioned by the Canadian Council on Animal Care.

Sexing

The ducks were sexed only at 49 d of age, just before their transport to the abattoir. As described previously the differences in vocalization between males and females served to determine the sex.

Slaughtering

The ducklings were sent at 49 d of age to the Brome Lake Ducks Limited. slaughter house to be processed. One male and one female duck from each pen which were close to the mean body weight were identified and these 48 carcasses were returned to our lab for measurement of carcass yield and carcass composition.

Feed and wastes sample analyses

Each food waste product was analyzed for the first experiment and these values were used for the formulation of the diets of the second experiment. An exception was the product okara in which the composition had changed as the result of a new processing in its manufacture. Each single batch of feed was sampled and subjected to proximate analysis. Since few variations in composition occur due to variability in the food wastes, averaging the analyses of the batches for a particular diet yields a better mean value of the nutritional composition for each treatment. Samples of wet food waste and wet mash feed were freeze-dried using a Virtis freeze-dryer[22]. The samples were then oven dried to obtain the absolute dry matter using a vacuum oven[23]. After being finely ground the samples were analyzed for crude protein using a nitrogen analyzer[24]. The gross energy was measured using an adiabatic oxygen bomb calorimeter[25]. The ash content was determined using a muffle furnace[26]. The calcium content was determined by flame atomic absorption spectrophotometer[27] after wet ashing with HNO_3. The phosphorus was determined by the alkalimeter ammonium molybdate method (AOAC, 1984), the optical density being read in a spectrophotometer[28] at 400 nanometres. The ADF was determined using the method developed by Van Soest.

Statistical analysis

The data were analysed using the General Linear Models Procedure for analysis of variance and using the contrast to determine significant differences. (SAS Institute, 1985). The model included the effects of the diet, block, and interaction. The

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[22]Virtis Freeze dryer # 278341, Gardiner, New York, USA

[23]National appliance company

[24]Leco FP-428, Leco corporation, St-Joseph, MI, USA

[25]Number 1241, Parr Instrument Company, Moline Illinois, USA

[26]Model F-A1730, Sybron Thermolyne Dubuque, Iowa, USA

[27]Model 2380, Perkin Elmer, Norwalk, CT60521

[28]Model Du-20, Beckman, Fullerton, CA 92713

design was factorial with 6 treatments, 2 blocks, and 2 replicates per treatment per block. The experimental treatments were contrasted with the control using F-test.

RESULTS

Mortality and culling

A total of 17 ducks were found dead in the pens of which 10 died within the first 48 hours. This represented a total mortality of 2.8%. A total of 23 birds were removed because of leg problems. Table 3.4 lists the mortality and culling for each treatment per week. Treatment 3 registered neither a death nor a cull; all other treatments had relatively similar numbers of dead or culled birds. Therefore no difference in mortality or culling rate can be ascribed to dietary treatment.

Table 3.4: Mortality and Culling[1]

Week	Treatments					
	1	2	3	4	5	6
first	0	1d[2]	0	1d	1d	1d
second	0	1d	0	0	1d	0
third	1c[2]	1c	0	0	0	1d 1c
fourth	2c	0	0	0	1c	1c
fifth	2c	3c	0	2c	3c	2c
sixth	0	0	0	0	0	1c
seventh	0	0	0	1c	1c	1c
total losses	5	6	0	4	7	8
dead	0	2	0	1	2	2
culled	5	4	0	3	5	6

[1] early death (0-48 hours) not included in the table
[2] c, culled; d, dead

Ducklings distribution per sex

The sex of the ducklings was determind just before transport to the abattoir. A total of 570 ducks were sent to the Brome Lake Ducks Limited processing plant. The culled and dead ducklings recorded during the experiment were not sexed. Of the remaining 570 ducks, 295 or 52% were males and 275 or 48% were females. The ducks had been distributed according to average body weight at 14 d of age into two different blocks, heavy or light, with 2 replicate pens of each treatment in each block. The end result was that the heavier weight block had 52% males and 47% females. The block of light body weight was composed of 48% males and 53% females.

Temperature

The ambiant temperature of the house was maintained at 30°C and 32°C under the heat lamp during the brooding period (0-14 days of age), August 02-16, 1995. After the brooding period, the temperature in the building fluctuated with the outside temperature since doors were kept open to increase the air circulation. Therefore from August 16 to September 20, 1995 (ducks 14 to 49 d of age) the temperatures recorded fluctuated between 11°C and 31°C with daily average of 24°C.

<u>Feed consumption</u>

The average feed consumption per duck by treatment is summarized in Table 3.5. The feed consumption values are reported on a dry matter basis and indicate the form in which the feed was consumed, either dry or wet mash feed and with the relative preference for each in parenthesis. The ducklings of Treatments 3,4 and 6 preferred the wet diet to the extent of 68,71 and 72% of the total, respectively. In Treatment 5 the ducks consumed about the same amount of dry and wet mash feed. In Treatment 2, ducks consumed only 20% of the chopped mix of equal proportion of vegetables and okara. The average consumption of the major nutrients per duck by treatment are summarized in Table 3.6. The total gross energy varied from 34,246 kcal per bird for Treatment 1 to 42,035 kcal per bird for Treatment 2. However, the consumption of fat was much more variable, from 359 g in Treatment 1 to as much as 1,330 g in Treatment 6. The consumption of crude protein was relatively similar with a range represented by Treatment 2 in which the ducks consumed 319 g more than the control and Treatment 3 with a consumption on average 154 g less than the control. The crude protein to fat ratio varied from 4.58 in Treatment 1 to 1.17 for Treatment 3. The study showed a significant difference in feed consumption between the heavy and light block ducks ($P<0.0001$), however, no statistical difference was observed between the 2 blocks ($P<0.68$) for feed conversion. Table 3.7 summarizes the feed consumption per duck by treatment for 3 different periods corresponding to the changes in feed for the commercial pelleted feed. The total feed consumption and the feed conversion at 49 d of age are reported on a dry matter basis. The analysis showed no statistical difference

(P>0.05) for the feed consumption between Treatments 1,3,5 and 6. However, ducks in Treatment 1 consumed on average less than those in Treatments 2 and 4 (P<0.0001). The analysis indicated no statistical difference (P>0.52) in feed conversion between Treatment 1 and Treatment 5. The control groups had a significantly (P<0.001) better feed conversion when compared to Treatments 2 and 4, however, the control had a feed conversion ratio statistically inferior (P<0.01) to Treatment 3 and to Treatment 6 which were formulated with only food waste.

Table 3.5: Average feed consumption per duck by treatment in the form of dry or wet mash feed on dry matter basis.

Treatment	Dry feed mash or pelleted (g)	Wet mash feed (g)	Total feed consumption (g)
1 Control pelleted feed	7,383 (100)[1]	- (0)	7,383 ± 95.63
2 Mac feed and vegetable mix	6,781 (80)	1,656 (20)	8,436 ± 95.63
3 Mac feed and wet mash	2,492 (32)	5,132 (68)	7,534 ± 95.63
4 Mac feed and wet mash	2,374 (29)	5,908 (71)	8,232 ± 95.63
5 Mac feed and wet mash	3,702 (49)	3,915 (51)	7,617 ± 95.63
6 Dry mash 6 and wet mash 100 % waste	2,101 (28)	5,465 (72)	7,566 ± 95.63

[1]Proportion of each feed consumed

Contrast
1 vs 2 p=0.0001 ***
1 vs 3 p=0.2876 ns
1 vs 4 p= 0.0001***
1 vs 5 p=0.1205 ns
1 vs 6 p=0.2021 ns

Table 3.6: Average consumption of the major nutrients by treatment based on total feed consumption per duck, on dry matter basis.

Treatment	D.M. g	Crude Prot g	Fat g	CP/fat ratio	G.E. Kcal	Ca g	P g	Ca/P ratio
Control pelleted feed	7,383	1,644	359	4.58	34,246	66	53	1.24
Mac dry feed and vegetable mix	8,436	1,963	984	1.99	42,035	86	70	1.23
Mac dry feed and wet mash 3	7,534	1,490	1271	1.17	38,660	64	55	1.16
Mac dry feed and wet mash 4	8,282	1,629	1169	1.39	41,702	71	61	1.16
Mac dry feed and wet mash 5	7,617	1,595	926	1.72	37,909	62	55	1.13
Dry mash 6 and wet mash 6 (100 % waste)	7,566	1,627	1330	1.22	38,647	62	54	1.15

Table 3.7: Total feed consumption by treatments and age period per duck (dry matter) and feed conversion to 49 days of age.

Dietary Treatment	Age period (days)				Feed conversion
	0-14	14-28	28-49	0-49	
	g	g	g	g	0-49d
1.Control pelleted feed	740	1910	4733	7383	2.18
2.Mac feed and vegetable mix	664	1959	5813	8436	2.54
3.Mac feed and wet mash 3	650	2120	4764	7534	2.03
4.Mac feed and wet mash 4	681	2176	5425	8282	2.36
5.Mac feed and wet mash 5	660	2092	4865	7617	2.20
6.Dry mash 6 and wet mash (100 % waste)	6 650	2088	4828	7566	2.02
SEM				±96	±0.03

Contrast total feed consumption
1 vs 2 p= 0.0001***
1 vs 3 p= 0.2876
1 vs 4 p= 0.0001***
1 vs 5 p= 0.1205
1 vs 6 p= 0.2021

Contrast feed conversion
1 vs 2 p= 0.0001***
1 vs 3 p= 0.0022***
1 vs 4 p= 0.0005***
1 vs 5 p= 0.5230
1 vs 6 p= 0.0014***

Contrast block feed conversion

	MEAN	±SEM
Light	2.2275	±0.015512
Heavy	2.2183	±0.045512

Contrast block feed consumption g

	MEAN	±SEM
Light	7548.58	±55.2098
Heavy	8032.08	±55.2098

Body weight gain and average daily gain

The average body weight gain and average daily gain (ADG) at 49 d of age by block and sex are summarized in Table 3.8. The heavy block gained more weight and had a better average daily gain than the light block ($P<0.0001$). Male ducklings had a greater weight gain and average daily gain than the females ($P<0.0001$). Table 3.9 shows the body weight gain and average daily gain at 49 d of age by treatment. The average daily gain paralleled the results for the final body weight at 49 days of age. The average daily gain for Treatment 2 was as good as Treatment 1 since no statistical difference was detected ($P>0.12$). Except for Treatment 2, all experimental treatments were significantly superior in average daily gain to the control. Treatment 3 with an ADG of 75.6 g/d was significantly higher ($P<0.0001$) than Treatment 1 (68.5g/d). Treatment 4 (72.5 g/d) was also significantly better than the control ($P<0.0006$). Treatment 5 (70.4 g/d) was also significantly better ($P<0.05$) and Treatment 6, with the feed composed entirely of food wastes, had the best over all ADG of 76.2 g/d and performed significantly better than the treatment control birds fed commercial pelleted feed ($P<0.0001$).

Table 3.8: Body weight gain and average daily gain from day 1 to 49 days of age by block and sex

Description	Body weight gain ± SEM	Average daily gain ± SEM
Block	g	g
Light	3,405 ± 17.03	69.49 ± 0.35
Heavy	3,624 ± 17.12	73.97 ± 0.35
AVG	3,514 ± 17.08	71.73 ± 0.35
SEX		
Female	3,382 ± 17.52	69.03 ± 0.36
Male	3,647 ± 16.72	74.44 ± 0.34
AVG	3,514 ± 17.12	71.73 ± 0.35

Block P ≤ 0.0001
Sex P ≤ 0.0001

Table 3.9: Body weight gain and average daily gain from day 1 to 49 days of age by treatment.

Treatment	Body weight gain ± SEM	AVG daily gain ± SEM
	g	g
1.Control pelleted feed	3,358 ± 29.68	68.54 ± 0.61
2.Mac feed and vegetable mix	3,289 ± 29.62	67.12 ± 0.60
3.Mac feed and wet mash 3	3,705 ± 28.84	75.61 ± 0.59
4.Mac feed and wet mash 4	3,553 ± 29.83	72.50 ± 0.61
5.Mac feed and wet mash 5	3,449 ± 30.05	70.39 ± 0.61
6.Dry mash 6 and wet mash 6 100 % waste	3,735 ± 29.45	76.23 ± 0.60
AVG	3,575 ± 29.58	71.76 ± 0.60

Contrast body weight gain	Contrast average daily gain
1 vs 2 p= 0.1248	1 vs 2 p= 0.1249
1 vs 3 p= 0.0001	1 vs 3 p= 0.0001
1 vs 4 p= 0.0006	1 vs 4 p= 0.0006
1 vs 5 p= 0.0524	1 vs 5 p= 0.0524
1 vs 6 p= 0.0001	1 vs 6 p= 0.0001

DISCUSSION

Wet and dry mash feed

The choice of offering a wet mash feed with a dry mash feed was the best feeding management to use since the diets in this experiment were made of food wastes varying in moisture content. Ducks in Treatments 3, 4 and 6 consumed a higher proportion (68.71% and 72%) of their total consumption as wet mash feed, respectively. Numerous studies have been cited in the previous experiment concerning the physical properties of the feed preferred by ducks. Pelleted feeds gave the best results when iso-energetic and iso- proteic diets were offered to ducks (Scott and Dean 1991). However, the objective of the present study was to minimize the transformation or processing of the industrial food wastes recycled into a complete diet. Therefore, chopping of some food wastes to facilitate mixing was utilized as the only additional step during processing. Although in this experiment iso-energetic and iso-proteic diets were not used, undoubtly better results were obtained (Treatments 3,4 and 6) when wet and dry mash feeds were offered in a free-choice setting to ducks when compared to the ducks in the control (Treatment 1) receiving only crumbled and pelleted feed.

Distribution of ducklings per sex and block

After the 570 ducks were sent to the slaughter house at 49 days of age, the data indicated that at 14 d of age the distribution had been relatively balanced for sexes within blocks. The males represented 52% of the flock and 52% of the males were included in the heavy block and 48% in the light block. The females accounted for 48% of the flock and 47% of the females were included in the heavy block and 53% in the light block. The results appeared to indicate a tremendous genetic variability for growth rate considering they were coming from the same parent stock. Within a same sex and treatment group, a difference of 1,626 grams was observed between the heaviest and lightest ducks at 49 d of age. Working in collaboration with Claude Trottier, General Manager at Brome Lake Ducks Limited of Knowlton, this study helped to identify more precisely a situation also observed in their commercial flocks. It seems to indicate rather clearly the low genetic selection pressure practiced to date in ducks. This suggests the probability that a program of genetic selection could yield a greater homogeneity of body weight, standardized carcasses and possibility also to market the ducks at an earlier age.

Mortality

This flock of ducks was characterized by a relatively high mortality rate, particularly early mortality since 15 ducklings (62.5%) died during the first 3 days. The ducklings were observed with mucus in the eyes causing the symptom of sticky eyes and preventing them from finding the feed, water and the heat source. One duckling was observed with pus in both eyes. At the Brome Lake farms the same problem was observed and they suspected that a ventilation problem at the hatchery was responsible for the high mortality rate. Further mortality was limited to 3 other ducklings which died during the experiment due to unknown causes. In addition, 23 ducks were culled due to legs problems. Only treatment 3 recorded no losses due to culling. All the other treatments had relatively similar numbers of deaths or culled ducklings and the differences were not significant among treatments. Perhaps the problem of higher mortality and leg problems was related to the fact that the ducklings were from a young parent flock (the average weight of the ducklings at day-old was only 45 g). The leg problems may have been related to the very rapid growth of these ducklings. In fact the average daily gain for the second experiment was 71.8 g/d compared to 63.6 g/d for the first experiment.

Crude protein-fat ratio

In a well balanced diet the metabolizability of the energy of feedstuffs by ducks has been found to be approximately the same as that of chickens.(Sherr and Dean, 1982; Ostrowski-Meissner, 1984; Lecqlercq and de Carville, 1985a). Therefore in assessing the energy value of feed to produce duck meat it is possible to use metabolizable energy values commonly accepted for poultry (Scott and Dean, 1991). For industrial food wastes, the metabolizable energy values of the feedstuffs have not been determined. The amount of fat consumed on average by the ducks in some treatments was greater than expected and may explain the better feed conversion observed for Treatments 3 and 6 which had eaten 810 g and 917 g of fat more than the control. Shen (1977-1979), testing unpelleted diets on the performance of mule ducks observed that during the growing finishing (4-10 w) period, feed conversion improved by about 5 % when energy was increased from 2600 to 3000 Kcal ME/kg. Scott and Dean (1991) recommend a ratio of energy:crude protein of 14 (ME/P) for optimal early growth and a ratio of 26 (3080 Kcal ME and 12% C.P.) for Pekin ducks from 2-7 weeks of age to provide maximum weight gain. To reduce the fat content of the carcass and to produce the best overall results, Scott and Dean (1991) suggested a ratio of ME/P between 17 and 19. Thus, a typical diet would contain 16-18% crude protein and 3059 Kcal ME/kg. The analysis of the carcasses indicate the effect of higher fat consumption on carcass composition for Treatments 3 and 6 when compared to the control treatment.

Body weight gain and average daily gain

The study demonstrated that all experimental treatments except for Treatment 2 were significantly superior when compared to the control treatment for total body weight gain and average daily gain. However, Treatments 2, 3, 4 and 6 had a better feed conversion than the control treatment. Treatment 3, with a feed conversion of 2.03, was significantly better ($P<0.0022$) than control Treatment 1 (2.18). Treatment 6 with a feed conversion of 2.02, the lowest of all experimental treatment was significantly different ($P<0.0014$) when compared to control treatment 1. It shows therefore that the experiment was very successful in the utilization of food waste in feeding ducks and provides a system for obtaining an added-value for industrial food wastes. Utilization of by-products such as brewer's grains is common in other species. Case and Polan (1994) found that dried brewer's grains appeared to be a superior protein supplement to enhance milk production in dairy cows ($P<0.01$). They also found that the dry matter intake was greater for cows receiving the dried brewer's grains which partially corresponded to the increase in milk production. When dried brewer's grains partially replaced soybean meal in the ration, an additional 5.2 g/d of methionine was available for absorption and milk production (Case and Polan 1994). The utilization of dried brewer's grains in dairy cattle feeding is therefore a good supplement of ruminally undegradable protein (rumen bypass) and justifies its use as a feedstuff but it should be remembered that this is an industrial food waste.

Utilization of food waste

The utilization of industrial food waste is becoming more and more popular for some countries such as Malaysia which must import feedstuffs. Large-scale duck rearing is not new to Malaysia but with the introduction of new breeds such as Pekin and Khaki Campbell a need to develop a commercial enterprise was created. Most of the diets are made of cheap local agricultural products and by-products. Since duck rearing with imported breed is a recent development, information on feeding standards is still incomplete. Therefore Yeong (1985), conducted some research and found that using 10% palm oil mill effluent, a waste of the palm oil industry, did not affect the body weight gain and feed/ gain ratio of Pekin ducks. Yeong (1985) also demonstrated that in laying ducks, broken rice is a better source of energy than corn. However, any change in feedstuff prices affects the profit margins in poultry. In tropical countries, the heavy dependence on imported conventional feedstuffs subjects the producer to external price fluctuations, providing greater incentives to use local agricultural products and by-products. Ravindran 1995, found no statistical difference ($P>0.05$) when using non conventional versus conventional feedstuffs for layers in Sri-Lanka; only the yolk colour was significantly improved ($P<0.05$). In that study, peanut skins were included in the mash feeds at a level of 2% in the starter, and 2.5% in the finisher. In our study peanut skins were incorporated at 2 and 3% in dry mash feeds, 2.0% in wet mash 5 and 7.0% in Treatment 6. The levels were limited because of the fat, fibre and tannic acid content of the peanut skins and also because of the possible contamination of the peanut skins with aflatoxin because ducks are highly susceptible to aflatoxin which, at the least, causes growth retardation. A study done by Utley and Hellwig (1985), demonstrated successfully the utilization of 10% peanut skin pelleted with bermuda grass and fed to calves. It improved their body weight gain by 27% ($P<0.05$) when compared to the control. In the Netherlands the use of garbage to feed poultry is under study. One of these studies using 30 % processed garbage in diets for chicken in conjunction with other essential ingredients achieved adequate results for body weight, feed consumption and feed conversion. Laying hens that were fed diets including up to 50% food waste responded by a dramatically increased feed consumption due to the high palatability, improved flavor and low energy content of this diet. These hens showed no appreciable difference in terms of egg production or egg quality (El Bouchy, 1994).

CONCLUSIONS

This experiment demonstrated that food waste, with minimal processing, wet mash feeding and only vitamins and mineral supplementation can partially or completely replace conventional feedstuffs to achieve growth performance of Pekin meat-type ducks equal to or surpassing that on conventional feedstuffs. Carcass fat was increased because of the high fat content of certain food wastes but this would be readily avoided by attention to dietary calorie:protein ratios in feed formulation. Although wet mash feeding was practical for this study its application by commercial producers would require some adaptation. However, utilization of large volumes by producers or feed companies will contribute toward lowering the cost of further processing procedures such as drying and pelleting and thus contribute toward increased recycling of food wastes into animal feeds, sparing conventional ingredients for human consumption, protecting the environment and promoting a more sustainable agriculture system.

SECTION IV

CARCASS YIELD AND COMPOSITION

The objective of this study was to assess the effects of dietary treatments on carcass yield and composition of White Pekin ducks at 49 days of age. The carcasses were the product of the two growth trials previously presented.

The original idea was provided by Dr. E.R. Chavez and Dr. S.P. Touchburn.

ABSTRACT:

Comparison of carcass yield and composition of ducks fed diets based on industrial food wastes and commercial feed.

This study was conducted to compare the carcass yield and composition of ducks fed either a commercial pelleted feed or experimental diets composed partially or entirely of industrial food wastes. From the two experiments, three different experimental treatments were chosen for assessement of carcass composition: control treatment (treatment 1) and the treatment formulated with only food wastes were selected plus the best intermediary treatment from each experiment was also selected for carcass analysis. In both studies it was found that the diets containing only industrial food wastes had significantly higher ($P<0.05$) fat contents than the controls. From each of the two feeding trials, four males and four females were selected which were close to the mean body weight for their respective treatment at 49 days of age. From Experiment 1 there was no significant difference ($P>0.05$) in carcass weight or carcass yield between the sexes or among dietary treatments with one exception, a lower carcass weight ($P<0.05$) for birds of treatment 3 which included a supplemental choice of chopped vegetables. In Experiment 2, three of the food waste-containing diets resulted in carcass weights significantly heavier ($P<0.05$) than that of the commercial control diet. In contrast to the first experiment, male carcasses were significantly heavier ($P=0.0001$) than female carcasses. However the females had a higher carcass yield ($P=0.0021$) than the males. This higher fat and consequently higher energy content was reflected in significantly

greater fat deposition in the carcasses. Overall, these studies demonstrated the successful use of food wastes as feedstuffs for growing ducks. Careful attention to the energy content of these diets will ensure a carcass quality acceptable to the consumer.

INTRODUCTION

The goal of most producers of poultry, pork or beef is to grow their animals to reach market weight as quickly as possible at minimum cost. Feed represents more than 60% of the cost of production. In the swine industry in Canada, producers are paid for the quality of the carcass, the price being based on an index determined according to the weight and the back fat thickness of the carcass. With an index of more than 100, the producer is paid more for the carcass, thus providing an incentive for the farmer to produce a leaner pig using the proper feed and appropriate genetic background. In the poultry industry such a system is not in place as yet. However, a private enterprise like Brome Lake Ducks Limited[29] which raises and commercializes their own product, must meet and surpass their competitors for the standard of quality demanded by the consumer. Care must be taken in feeding ducks for meat production. Ducks and all other waterfowl normally deposit thick layers of subcutaneous and abdominal fat which serve important physiological functions in their natural habitat (Scott and Dean, 1991). The thick layer of fat is mainly present to reduce heat loss when the ducks are in their natural habitat (Hagen and Heath, 1980).

[29]Brome Lake Ducks, Limited, Knowlton, Québec, Canada

Around the world, duck meat is a preferred food for some people for different reasons. In Asia, duck is a preferred and a practical choice. In other societies among people for whom food is scarce the fat of the ducks is cherished for its taste and food energy (Scott and Dean, 1991). In most industrial countries, duck meat is favoured more for its unique gastronomic qualities. Health concerns of these people made them resist including duck in their day-to-day diet. Therefore, duck producers are being forced to pay more attention to the factors that influence carcass composition.(Scott and Dean, 1991). Modern breeds were selected to grow faster, and in consequence, more fat deposition occurs than in the traditional breeds (Abdelsamie and Farrell, 1985). Therefore manipulation of carcass composition by genetic selection is oriented towards increasing the breast muscle size, increasing meat yield and reducing fat (Abdelsamie and Farrell, 1985). Other factors influence carcass characteristics: namely ambiant temperature, sex, crossbreeding and diet, particularly the protein-energy ratio (Abdelsamie and Farrell, 1985). The ultimate goal in the production of modern meat duck is to increase the cooking yield by reducing carcass fat and thus the loss of fat by dripping while increasing the total meat content.

After having successfully raised 2 flocks of ducks to market weight during the summer of 1995, on experimental diets, the measurement of the carcass yield of each dietary treatment and the evaluation of the carcass composition of the more interesting treatments were considered necessary. It is important to assess the influence of feeding industrial food waste on the carcass characteristics and yield for the producer as well as for the consumer. If some adverse effects were found, modification or limitations of certain food wastes would have to be considered.

MATERIALS AND METHODS

Carcass sampling

A total of ninety-six eviscerated, dressed carcasses were recovered from the abattoir to measure carcass yield and forty-eight out of them were used to determine carcass composition. All the carcasses were from the two studies conducted during the summer of 1995. The ducks were processed at 49 days of age at Brome Lake Ducks Limited[30] following standard practice.

Experimental design

From the 600 ducks raised in each of the two trials, one male and one female per pen were selected for carcass yield. The selection was done at random, but the ducks selected were chosen to be close to the pen mean weight. Therefore, a total of 4 males and 4 females (2 heavy, 2 light of each sex) were selected for each treatment. Subsequently, three dietary treatments of main interest in each of the experiments were included for carcass composition analysis. In the two studies, Treatment 1, the control, fed commercial pelleted feed and Treatment 6 which was fed almost exclusively with food wastes were included. The best intermediate treatment (treatments which were not exclusively fed with commercial or food wastes) from each of the two studies was also

[30]Brome Lake Ducks, Limited, Knowlton, Québec, Canada

included, namely, Treatment 4 from Experiment 1 and Treatment 3 from Experiment 2.

Duck processing

The ducks were processed at the abattoir to provide the empty shell plus neck and giblets. The carcasses were received frozen so the carcass yield was measured using the frozen carcass weight and the live body weight of the ducks before they were transported to the processing plant. For the analysis of carcass composition the frozen carcasses were cut in half longitudinally along the back bone using a butcher's band saw[31] and one half was used for the analysis. The dissection of the half-carcass was done with a surgical scalpel after the carcasses had been thawed. The dissected half-carcass was fractionated into the following four components: lean meat, skin plus subcutaneous fat, intermuscular fat and bone. The neck and giblets (heart, liver and gizzard) were excluded. Each fraction was then expressed as a percentage of the total eviscerated carcass weight.

Statistical analysis

The data were analyzed using the General Linear Models procedure for analysis of variance, (S.A.S. Institute, 1985). The model included the effects of the diet, block, and interaction. The dependent variable were carcass yield and carcass composition parameters.

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[31]Butcher Boy Model B14, Lasar MFG Company Inc., Los Angeles, CA, USA

The design was factorial with 3 treatments, 2 blocks, and 2 replicates per treatment per block. The experimental treatments were contrasted with the control using F-test.

Experimental treatment

The various treatments consisted of the control and food-waste containing experimental diets fed to the ducks in Experiments 1 and 2, described in detail in the previous sections. However, the main difference among the dietary treatments was related to the proportions of energy and protein consumed as reflected in the crude protein: fat ratio. Table 4.1 lists the amount of each nutrient consumed and the resultant ratio of protein:fat, the variable which could have the greatest influence on carcass composition. The statistical analysis was performed separately for each study. Although the same breed was used, the ducks were obtained from different parent stocks and the feeding trials were carried out at different times. The preparation of the carcasses was performed with the same method of dissection and separation throughout both trials.

Table 4.1: Mean consumption of the major nutrients per duck in Experiments 1 and 2.

Treatment	D.M. g	C. P. g	Fat g	Ca g	P g	C.P.:Fat ratio
EXPERIMENT 1						
1	7,159	1,607	342	64	52	4,7
4	7,611	1,522	891	67	57	1,7
6	7,526	1,656	941	69	55	1,8
EXPERIMENT 2						
1	7,383	1,645	359	66	54	4,6
3	7,534	1,495	1266	64	56	1,2
6	7,566	1,531	829	63	53	1,8

RESULTS EXPERIMENT 1

The mean carcass weights and yields for all the treatments are summarized in Table 4.2. There was no statistically significant difference ($P<0.05$) for the carcass weight between any treatment and the control except the contrast of Treatments 1 and 3 ($P< 0.05$). There was no significant difference in carcass weight between males and females ($P=0.18$). The females in Treatment 4, heavy block had the overall highest carcass weight (2,660 kg). A highly significant difference ($P=0.04$), was observed between the two blocks. The heavy block (heavier body weight) produced a heavier carcass weight. There was no significant difference for the dressing percentage or carcass yield among treatments ($P=0.11$) or between sexes of ($P=0.17$).

The effect of dietary treatment and sex on the carcass components of ducks at 49 days of age are summarized in Table 4.3. There was no significant difference ($P=0.74$) in the percentage of skin between males and females. There was also no significant difference ($P=0.06$) in the intermuscular fat content between males and females. However, a tendency can be seen for female ducks to have more fat in their carcasses. The skin and fat percentage indicated the same trend ($P=0.10$). There was a significant difference in the meat percentage ($P=0.02$) indicating that males have more lean meat than females. Also, males seemed to have greater bone structure since the percent of bone content was significantly higher ($P=0.03$).

Table 4.2: The effect of dietary treatment on live body weight, carcass weight and carcass yield of Pekin ducks at 49 days of age for experiment 1.

Treatment	Body weight[1] g	Carcass weight[1] g	Carcass yield [1] %
1	3,192 ± 61.26	2,338 ± 61.34	71.82 ± 1.40
2	3,151 ± 59.41	2,311 ± 61.34	72.45 ± 1.40
3	3,031 ± 59.86	2,146 ± 61.34	71.75 ± 1.40
4	3,321 ± 61.46	2,439 ± 75.13	73.13 ± 1.72
5	3,128 ± 61.40	2,349 ± 75.13	72.96 ± 1.72
6	3,274 ± 59.77	2,248 ± 61.34	69.33 ± 1.40

	Carcass wt	MEAN[1]	P-value
Block	Heavy	2,368 ± 35.41	
	Light	2,242 ± 40.89	0.04*
Sex	Male	2,267 ± 38.25	
	Female	2,344 ± 38.25	0.18 N.S.
	Carcass yield (%)		
Block	Heavy	72.59 ± 0.81	
	Light	71.23 ± 0.93	0.29 N.S.
Sex	Male	72.70 ± 0.87	
	Female	71.12 ± 0.87	0.23 N.S.

[1] ±SEM

Contrast carcass weight
1 vs 2 (p=0.77) N.S.
1 vs 3 (p=0.05)*
1 vs 4 (p=0.31) N.S.
1 vs 5 (p=0.91) N.S.
1 vs 6 (p=0.32) N.S.

Table 4.3: Effect of dietary treatment and sex on carcass components[1] of Pekin ducks at 49 days of age for experiment1

Treatment	Sex	Carcass weight[2]	Skin[3]	Meat	Bone[4]	Fat[5]	Skin and fat[6]
		g	%	%	%	%	%
1	female	2,285	31.08	41.62	21.39	5.92	37.00
	male	2,390	31.60	42.37	22.32	3.71	35.31
4	female	2,439	37.48	38.73	18.68	5.11	42.59
	male	2,440	37.03	36.74	19.23	4.50	41.53
6	female	2,150	36.32	38.40	20.46	4.97	41.30
	male	2,346	35.22	36.13	23.69	4.96	40.18
SEM±		86.75	1.12	0.42	0.64	0.47	0.74

[1] Percentage of cut-up-parts expressed on eviscerated carcass weight without neck and giblets
[2]Carcass weight including neck and giblets
[3]Skin and subcutaneous fat
[4]Bones, cartilage and adhering tissues remaining after deboning
[5]Intermuscular fat
[6]Skin, subcutaneous fat and intermuscular fat

Table 4.4: Comparison of male and female Pekin ducks for the components of carcass composition as percent of eviscerated carcass weight for Experiment 1.

Component (%)	Sex	MEAN[1]	P-value
Skin	female	34.96 ± 0.64	
	male	34.62 ± 0.74	0.74 N.S.
Meat	female	39.58 ± 0.24	
	male	38.42 ± 0.28	0.02 *
Bone	female	20.18 ± 0.37	
	male	21.74 ± 0.43	0.03 *
Fat	female	5.33 ± 0.27	
	male	4.39 ± 0.31	0,06 N.S.
Skin and fat	female	40.29 ± 0.43	
	male	39.01 ± 0.50	0.10 N.S.

[1]Mean ± SEM

Table 4.4 summarized the overall carcass components between males and females for Experiment 1. Overall, there were no statistically significant differences ($P>0.05$) between the two blocks for the skin, bone, fat and skin plus fat content of the carcasses. However, there was a significant difference ($P=0.003$) between the two weight blocks of ducks for the lean meat content. The females had a statistically ($P=0.02$) higher meat percentage compared to the males. The males had a statistically ($P=0.03$) higher percentage of bone than females. Those results can be explained by the fact that the males might have a bigger bone structure compared to the females or more adhering tissue were left on the males bones.

The effects of dietary treatments on carcass composition of ducks at 49 days of age are summarized in Table 4.5. It can be observed that Treatment 1 had significantly less skin plus subcutaneous fat when compared to Treatment 4 ($P=0.003$) and Treatment 6 ($P=0.007$). Treatment 1 also had a significantly higher percentage of lean meat when compared to Treatment 4 ($P=0.0001$) and Treatment 6 ($P=0.0001$). It was also observed that the total body fat of Treatment 1 was significantly less than that of Treatment 4 ($P=0.0004$) and treatment 6 ($P=0.0008$).

Table 4.5: Effect of dietary treatment on carcass components[1] of Pekin ducks at 49 days of age for Experiment 1.

Treatment	Carcass[2]	Skin[3]	Meat	Bone[4]	Fat	Skin and fat[6]
	g	%	%	%	%	%
1	2,338	31.34	41.99	21.85	4.82	36.15
S.E.M.	±61.34	±0.79	±0.30	±0.46	±0.33	±0.53
4	2,439	37.26	37.74	18.95	4.80	42.06
S.E.M.	±75.13	±0.97	±0.36	±0.56	±0.41	±0.64
6	2,248	35.77	37.26	22.07	4.96	40.74
S.E.M.	±61.34	±0.79	±0.30	±0.46	±0.33	±0.53

[1]Components expressed on an eviscerated carcass weight excluding the neck and giblets.
[2]Carcass weight including neck and giblets.
[3]Skin plus subcutaneous fat.
[4]Bones, cartilages and adhering tissues remaining after deboning.
[5]Intermuscular fat.
[6]Total skin, subcutaneous fat and intermuscular fat.

Contrast: Skin :
1 vs 4 (P=0.003) ***
1 vs 6 (P=0.007) ***
Meat:
1 vs 4 (P=0.0001) ****
1 vs 6 (P=0.0001) ****
Bone:
1 vs 4 (P=0.007) ***
1 vs 6 (P=0.74) N.S.
Fat:
1 vs 4 (P=0.98) N.S.
1 vs 6(P=0.75) N.S.
Skin and fat:
1 vs 4 (P=0.0004)
1 vs 6 (P=0.0008)

RESULTS EXPERIMENT 2

Table 4.6 summarizes the results obtained on live body weight, eviscerated carcass weight and the calculated carcass yield. It was observed that Treatment 3 and Treatment 6, using only waste, had significantly higher carcass weights than the control ($P=0.003$) and ($P=0.0001$), respectively. Treatments 2 and 4 were not significantly different from the control ($P>0.05$). As in Experiment 1, there was a significant difference ($P=0.0001$) between blocks. The heavy block having a significantly higher carcass weight than the light block. There was a significant difference ($P=0.0001$) between males and females for carcass weight. The average carcass weight was 2,754 g and 2,547 g for males and females, respectively. The carcass yield showed no statistically significant difference between treatments ($P>0.05$) but the heavy block had a higher yield ($P=0.058$) than the light block and females had a higher carcass yield than males ($P=0.002$).

Table 4.7 summarizes the effects of dietary treatment and sex on carcass components of ducks at 49 days of age. There was no significant difference ($P>0.05$) between blocks for all the carcass components measured. The same observation was obtained between sexes ($P>0.05$). However, the females showed a trend ($P=0.0538$) to have more bone than the males. It was also observed that the males from treatment 6 had the highest carcass weight, 3,001 g.

Table 4.8 shows the effect of dietary treatment on carcass components of ducks at 49 days of age. Treatment 6 showed a tendency of having more skin and subcutaneous fat than the control (P=0.10). Treatments 3 and 6 had significantly more fat in the carcass when compared to the control (P=0.02 and P=0.03 respectively). All the other parameters for fat, bone, and intermuscular fat showed no significant difference (P>0.05) among treatments.

Table 4.6a: The effect of dietary treatment on live body weight, carcass weight and carcass yield in experiment 2.

Treatment	Live body weight[1]	Carcass weight[2]	Carcass yield %
	g	g	g
1	3,470	2,515	72.54
2	3,468	2,554	73.65
3	3,777	2,772	73.46
4	3,582	2,590	72.57
5	3,574	2,645	74.05
6	3,838	2,816	73.39
S.E.M	±30.04	±36.75	±0.61

[1]Live body weight at 49 days of age of males and females.
[2]Eviscerated carcass weight including neck and giblets

Contrast carcass weight: 1 vs 2 (P=0.47) N.S.
1 vs 3 (P=0.0003) ***
1 vs 4 (P=0.13) N.S.
1 vs 5 (P=0.03) *
1 vs 6 (P=0.0001) ***

Table 4.6b: The effect of dietary treatment on carcass weight per sex and block for all treatments of experiment 2.

			Mean ± S.E.M	P-value
Carcass weight (kg)	Block	heavy	2,742 ± 21.22	
		Light	2,558 ± 21.22	0.0001****
	Sex	female	2,547 ± 21.22	
		male	2,754 ± 21.22	0.0001****
Carcass yield (%)	Block	heavy	73.57 ± 0.35	
		light	72.98 ± 0.35	0.2603 N.S.
	Sex	female	74.24 ± 0.35	
		male	72.30 ± 0.35	0.0021***

Table 4.7: Effect of dietary treatment and sex on carcass components of Pekin ducks at 49 days of age for experiment 2.

Treatment	Sex	Carc. Wt[2]	Skin[3]	Meat	Bone[4]	fat[5]	Skin and fat[6]
		g	%	%	%	%	%
1	female	2,456	28.69	39.85	24.95	6.51	35.20
	male	2,574	30.34	39.66	23.90	6.09	36.43
3	female	2,761	33.09	36.36	21.74	8.81	41.90
	male	2,782	35.27	39.81	18.02	6.89	42.16
6	female	2,632	34.64	37.70	21.02	6.64	41.28
	male	3,001	35.88	39.52	18.26	6.34	42.22
S.E.M.		51.97	2.92	2.53	1.28	1.15	2.10

[1]Percentage of components expressed on an eviscerated carcass excluding the neck and the giblets
[2]Carcass weight including neck and giblets
[3]Skin and subcutaneous fat
[4]Bones, cartilages and adhering tissues remaining after deboning
[5]Intermuscular fat
[6]Skin, subcutaneous fat and intermuscular fat

Component (%)	Sex	MEAN (%)	P-value
Skin	female	32.40 ± 1.69	
	male	33.83 ± 1.69	0.50
Meat	female	37.97 ± 1.46	
	male	39.66 ± 1.46	0.44
Bone	female	22.57 ± 0.74	
	male	20.00 ± 0.74	0.05
Fat	female	7.32 ± 0.67	
	male	6.44 ± 0.67	0.39
Skin and fat	female	39.46 ± 1.21	
	male	40.27 ± 1.21	0.65

Table 4.8: Effect of dietary treatment on the carcass components[1] of Pekin ducks at 49 days of age for experiment 2.

Treatment	Carcass[2]	Skin[3]	Meat	Bone[4]	Fat[5]	Skin and fat[6]
	g	%	%	%	%	%
1	2,515	29.52	39.76	24.43	6.30	35.82
3	2,772	34.18	38.09	19.88	7.85	42.03
6	2,816	35.26	38.61	19.64	6.49	41.75
S.E.M.	36.65	2.06	1.79	0.91	0.82	1.48

[1] Components expressed on an eviscerated carcass weight excluding the neck and the giblets
[2] Carcass weight including neck and giblets
[3]Skin and subcutaneous fat
[4]Bones, cartilages and adhering tissues
[5]Intermuscular fat
[6]Skin, subcutaneous fat and intermuscular fat

Contrast:	Skin (%):	1 vs 3 (P=0.16) N.S.
		1 vs 6 (P=0.10) N.S.
	Meat (%):	1 vs 3 (P=0.53) N.S.
		1 vs 6 (P=0.67) N.S.
	Bone (%):	1 vs 3 (P=0.01) **
		1 vs 6 (P=0.01) ***
	Fat (%):	1 vs 3 (P=0.23) N.S.
		1 vs 6 (P=0.88) N.S.
	Skin and fat (%):	1 vs 3 (P=0.02) **
		1 vs 6 (P=0.03) **

DISCUSSION

The carcass yields obtained by dividing the carcass weight including the neck and the giblets by the live body weight at 49 days of age were similar for the two experiments. An overall carcass yield of 71.91% and 73.28% were obtained for the first and second experiments, respectively. Campbell et al. (1985) obtained a carcass yield of 60% for White Pekins with a live body weight of 2.15 kg at 56 days of age. But since that time genetic selection has favored fast growth and increased body size influencing the carcass weight and yield of today's strains of White Pekin ducks. In the two feeding trials conducted it was observed that the ducks exhibited a tremendous variability in live body weight. That live body weight difference is obviously reflected in the carcass weight. The same results were observed in both experiments; the heavy body weight block had significantly heavier carcass weights than the light block (P=0.04 in Experiment 1 ; P=0.0001 in Experiment 2). In the first experiment no statistically significant difference was found (P=0.18) between males and females for carcass weight and for carcass yield (P=0.3). In the second experiment the males had a higher (P=0.0001) carcass weight than the females (2,754 vs 2,547g). However females had a better carcass yield than the males (P=0.002). This is in contrast to the results of Campbell et al. (1985) and Scott and Dean (1991) who reported the same carcass yield for males and females. Reports on the effects of sex on carcass composition are conflicting and variable (Abdelsamie and Farrell, 1986). In Experiment 1, here the females had significantly (P=0.02) more meat, less bone (P=0.03) and a tendency toward more fat (P=0.06) and more total carcass fat (P=0.10) than the males. In the second experiment, in contrast females had more bone (P=0.05) than the males. All the other components were not significantly different from the results obtained in the first experiment. However in both experiments the value obtained for the meat, bone and total carcass fat are comparable to the composition reported by Scott and Dean (1991). With a mean carcass weight of 1,978 grams from White Pekin ducks, Scott and Dean (1991), obtained a partition of 40% carcass fat, 35% lean muscle and 25% bone and adhering tissue. Based on these results it can be said that, even if there is an increase in the carcass weight of White Pekin ducks, the carcass composition is maintained relatively the same.

The main factors capable of affecting the carcass composition in the two experiments were the feed composition and its level of consumption. Table 4.1 lists the relative consumption of the major nutrients. For all the diets prepared at the Macdonald Campus, the amount consumed provided a much greater intake of fat than did the control (commercial pelleted feed). That higher consumption of fat by these treatments was reflected in the carcass composition. In fact, Treatments 4 and 6 in Experiment 1 and Treatments 3 and 6 in Experiment 2 had significantly ($P > 0.05$) more total body fat than the control treatment 1. Siregar et al. (1985) demonstrated quite clearly for White Pekin ducks grown to 56 days of age that the ratio of dietary energy to crude protein which increased from about 500 to 1200, resulted in a linear increase in carcass fat and a decline in carcass protein composition for males and females. It was not possible to determine the metabolisable energy of the experimental diets without knowing the metabolizable energy values of the waste ingredients. However we know the content of fat and crude protein for each diet and thus, the amount of each consumed by the ducks for each treatment. The ducks fed Treatments 4 and 6 in Experiment 1 and Treatments 3 and 6 in Experiment 2 consumed more fat and the protein/fat ratio was about 3 times lower than that of the control. Since fat is very highly digestible, high fat consumption will increase body fat deposition. Campbell et al. (1985) reported that the carcass fat content increases curvilinearly with food intake and approaches a maximum value which is determined by sex and rate of energy intake. They also mentioned that the carcass fat content at 56 days of age for White Pekin ducks might be due to a rapid growth during the starting period which is characterized by rapid fat development. They suggest therefore a food restriction during the first 2 or 3 weeks of life. Our results are in disagreement with this statement because in Experiment 1, all the ducklings were fed the commercial starter feed for the first 14 d and received the experimental diets only after those 14 d. Therefore, the fat contained in each experimental diet was the main factor affecting the quantity of fat found in the carcass. In these experiments the ducklings consumed 60-65% of their total feed consumption between days 28 and 49. The main factors known to influence the carcass composition are genetics, diet, sex, age and the environment (Abdelsamie and Farrell, 1985). In the experiments reported here, the most likely factor to influence the carcass composition was the diet, followed by the genetics (since the ducklings were from two different parent flocks) and perhaps, to a lesser extent the ambient temperature which was a little cooler for the second experiment. The housing and all other conditions were similar.

The carcass composition of ducks is to a certain degree related to body size. As body weight at a given age increases in Pekin ducklings, the weight of both muscle and fat tissues increases but there is a proportionately greater increase in fat than in muscle (Scott and Dean, 1991). This supports our decision to select at random ducklings that were close to the average weight of each replicate to determine the carcass composition of males and females and to measure the effect of the diet on carcass composition. We found no significant difference ($P > 0.05$) between blocks, when expressed as a percent of the eviscerated carcass without the neck and giblets .

Based on the experimental results it is apparent that for a better utilization of some food waste products, they should be limited in the ration to reduce the amount of fat consumed and deposited in the carcass. However, the limit should be defined very carefully because some of these same food wastes are relatively good sources of protein. The final carcass produced contains good quality meat even though the carcass fat content is higher. The carcass fat content of the ducks fed the different test diets was not detectable by visual inspection. Only the detailed dissection allowed us to measure the higher fat content in the carcasses from some treatments. Since it is well known that people have a prejudice against duck meat because of its fat content, selection of breeds or cross-breeding programs should be a part of the strategy along with nutritional manipulation to reduce the fat content of the carcass. Important is the cooking yield of duck meat which will encourage repeat purchase and consumption of ducks. The excessive amount of fat rendered from the carcass is not appreciated by the health conscious public. In conclusion, the duck can be an excellent food waste converter as long as care is taken to maintain the quality of the product for consumer satisfaction and confidence.

CONCLUSIONS

This experiment demonstrated that food waste, with minimal processing, wet mash feeding and only vitamin and mineral supplementation can partially or completely replace conventional feedstuffs to achieve growth performance of Pekin meat type ducks equal to or surpassing that on conventional feedstuffs. Carcass fat was increased because of the high fat content of certain food wastes but this would be readily avoided by attention to dietary calorie:protein ratios in feed formulation.

GENERAL DISCUSSION

The rapid population growth at a rate of 90 million people per year (Brown 1996) represents a tremendous pressure on agricultural production because the additional people must be fed with the same global resources supplied by the land and the ocean. In animal production the farmer but more frequently the feed company have the choice of selecting ingredients to make balanced diets. By using industrial food wastes it will be possible to formulate diets more efficiently and at least cost by increasing the number of ingredients available and at the same time protecting the environment.

In order to minimize the processing of the industrial food wastes in these two trials, the ducklings were offered a dry mash feed along with a wet mash feed. Scott and Dean (1991) reported that in the early development of commercial operations on Long Island, wet feed was commonly fed to the ducks but was a tedious task. However it was demonstrated that the ducklings showed a preference for the wet mash feed when having access to both in a free-choice feeding system. This observation was further extended in the current trials in that, when the ducks had a choice between eating pelleted feed and wet feed they still preferred the wet feed. Wilson (1973) found no difference in live body weight when White Pekin ducks were fed the same diet as mash, crumbles or pellets. In the two experiments presented in this thesis all the experimental diets were different in composition and different average live body weights were obtained at 49 d of age. In fact, in both experiments, feeding food wastes or chopped vegetables to ducklings was characterized by a higher feed consumption when compared to the commercial pelleted feed (control group). As noticed by Wilson (1973) feeding mash to ducks increased the feed wastage in the waterers and around them although the amount was not measured. In the two studies presented here the feed wastage was likewise not measured.

Heuser and Scott (1951) observed that White Pekin ducklings receiving a free choice of dry and wet mash feed grew at approximately the same relative rate as ducks receiving pelleted feed from 4 to 9 weeks of age. They observed that ducks receiving pelleted feed were the heaviest at the end of the trials. In the two experiments reported in this thesis, the weights of the ducks in the different experimental diets and those of the ducks in the control diet at 49 d of age (Experiment 1) showed no significant difference ($P>0.05$).

In the second experiment, four treatments showed significantly higher live body weights than the control. The body weight gains were highly significant for Treatments 3, 4 and 6 ($P<0.001$) and for Treatment 5 ($P<0.05$). Treatments 3, 4 and 5 received 21d of Mac starter which contained about 50% food wastes and 50% conventional ingredients, 28d of Mac grower-finisher containing food wastes and conventional feedstuffs in about the same proportions. All three of these treatments also offered the wet feed which contained only food waste. Treatment 6 was 14d of the Mac starter and 35 days of a dry mix containing only food wastes as well as the wet feed. The feed conversion values for Treatments 3 and 6 were significantly better than that of the control ($P<0.01$) and not significantly different from Treatment 5 ($P>0.05$). The carcass weight of the treatments of the second trials showed a significantly higher carcass weight for Treatments 3 and 6 ($P<0.001$) when contrasted with the control. The average consumption per duck of the major nutrients in Table 2.6 indicated that the consumption of fat (energy) was at least 3 times higher than the control and the ratio crude protein:energy varied from 4.6 for the control to 1.2 for Treatment 3. The nutritive value of the industrial food wastes was demonstrated to be comparable to those of conventional feedstuffs in the two experiments reported herein by the fact that ducks consuming them produced carcasses of similar quality to ducks fed commercial feed. However, one limitation of using industrial food wastes in a well balanced formulation is the fact that their nutritive value is not well known. Another limitation is their uncertain availability and variable composition, which means that chemical analyses are required more often than for conventional feedstuffs to ensure the right formulation and substitution by other wastes to complete the diet. Experimental diets of the first and second studies were different due to a shortage of some food wastes products which led to an improved ration formulation. A different combination of wastes in the second experiment resulted in improved growth performance over that of Experiment 1.

Wet feeding is a tedious task and presents greater risk due to the possibility of mold development. However, development of wet feeding technology in poultry would be worthwhile, especially with ducks. This will allow the use of some industrial food wastes in which the water content could be a limitation for their utilization by producers. Using broilers, Yalda and Forbes, (1995) observed a 10% increase in feed efficiency by adding water to a commercial pelleted feed in experimental and commercial conditions. The wet feeding seemed to stimulate growth directly due to an improvement in diet digestibility and more specifically protein digestibility (Yalda and Forbes, 1995). The effect of wet feeding appears to have increased the size of the crop and intestine since their weights increased and could be responsible for a higher digestibility of food (Yalda and Forbes, 1995). Using an inert marker in the food and measuring the concentration at different sites in the digestive tract led these workers to suggest the occurence of a more rapid solubilization of food constituents with wet food (Yalda and Forbes, 1995). Therefore, it was suggested that this early solubilization may give more time for absorption in avian species in which the transit time of food is normally particularly rapid. It is also possible that wetting of the food activates endogenous enzymes. Fry et al. (1958), reported that addition of water and soaking of barley for 8 hours and drying before feeding, increased the nutritive value of barley. Considering the low cost of the industrial food wastes available, their use in a complete formulation of a wet feed may offer considerable commercial benefit. Suitable equipment would need to be developed for mixing and delivering the wet mix to the birds while at the same time limiting mold development. Also, other industrial food wastes which contain a high percentage of water such as whey from the cheese industry, whey from tofu production and brewers yeast which are most often flushed into sewers can be efficiently utilized in either a mix with a commercial dry feed or dry food wastes to obtain a wet mix.

The utilization of industrial food wastes in animal feeding is economically attractive and provides an environmental solution to global waste production. The increasing interest in these industrial food wastes will promote more research to know them better and with time they will be considered as conventional feedstuffs. In the two studies presented here, it was demonstrated that a higher consumption of fat from industrial food wastes produced a carcass with a higher fat content. Because this product would not be accepted by health conscious consumers new formulation should correct this effect, simply by taking into account the actual fat and total caloric content of these new ingredients. The nutritive value of industrial food wastes in animal feeding was well demonstrated in this thesis, but still more of them remain to be discovered and to be evaluated for their nutritional contribution as potential feed ingredients for all types of farm animals. The main limitation of food waste utilization in animal feeding for the Province of Quebec is the rigid organization, frequently contractual, in place between producers, feed companies and slaughter houses for the guaranty of delivery in the present intensive production system. The feeding equipment is also more oriented toward dry feeding but it may be interesting to return to wet feeding for some species such as pigs, poultry and ducks. It is not an easy task to change the present production system towards a new and novel production system based on feeding and utilizing food wastes. However, facing the prospect of food crisis in the near future as a consequence of the increasing human population, some adjustments will have to be made to maximize the use of all resources available, including recycling the industrial food wastes into animal agriculture.

GENERAL CONCLUSION

Industrial food waste can be collected and recycled for feeding animals. Two consecutive experiments clearly demonstrated that it is possible to raise Pekin ducklings using industrial food wastes with minimal processing. The nutritive value of the food wastes for growing market ducklings was clearly assessed and their potential illustrated as assets too valuable not to be utilized. Feeding industrial food wastes is almost like feeding grains in some cases excepted that they have been transformed; for example, feeding bread is like feeding wheat, therefore why lose these valuable ingredients? The two experiments demonstrated that ducklings fed industrial food waste reached market weight at the same time as those fed a commercial diet but with a better feed conversion in some cases. Both studies demonstrated that the carcass quality and appearance of ducks fed the commercial feed or the food waste diets were indistinguishable in appearance. Only the cooking yield may be expected to be somewhat different due to the higher fat content of the carcasses of ducks receiving food wastes. These fatter carcasses can be avoided in the future by formulating differently and by having more information through further research on the digestibility and the metabolizable energy value of the food wastes. Therefore it is perfectly possible and highly beneficial to produce duck meat using industrial food wastes and providing a carcass acceptable to the consumer. On a large scale basis, using industrial food wastes, the cost of producing ducks will be reduced, providing the farmer an opportunity to make a greater profit. Sustainable agriculture is an attainable objective for the Province of Quebec, recycling food wastes is one step toward achieving this goal. The results presented in this thesis demonstrate that industrial food wastes represent a valuable resource capable of replacing conventional ingredients, sparing grain for human consumption and contributing towards a sustainable agriculture.

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APPENDIX A

Projet de Recyclage de Déchets Alimentaires/Organic Waste Recycling Project
Département des sciences animales/*Animal Science Department*
Campus Macdonald de l'Université McGill/*Macdonald Campus of McGill University*
21,111 Lakeshore, Ste. Anne de Bellevue, P.Q. H9X 3V9
Phone: (514) 398-7738 Fax: (514) 398-7964

---

1. Nom de votre entreprise/*Company name*: ....
   Address/*Address*: ....
   Code Postale/*Postal Code*: ....

2. Votre nom/*Your name*: ....
   Titre/*Position*: ....
   Numéro de téléphone et télécopieur/
   Phone & fax numbers: ....

3. Veuillez s.v.p. remplir ce tableau,utilisant les options donnés autant que possible.
   Please complete the table using the options available.

Type de déchet alimentaire. *Description of waste.*	Quantité par semaine *Amount per week* litres/lbs/tonnes/m^3/kg *liters/lbs/tons/m^3/kg*	Coût de l'elimination par semaine/*Cost of disposal per week* $valeur/gratuit/confidential/ ne sais pas/*$value/free/ confidential/do not know*	Réfrigération? *Refrigeration?* Oui/Non *Yes/No*
1)			
2)			
3)			

4. De quelles manières vous débarrassez-vous de ces déchets présentement?
   How do you dispose of your waste at this time?
   - Déchets municipaux/*City garbage* ________
   - Incinération/*Incineration* ________
   - Enfouissement/*Landfill* ________
   - Compost/*Compost* ________
   - Infrastructures spécialisées/*Special Facilities* ________
   - Ne sais pas/*Do not know* ________

5. Seriez-vous interessé à faire partie d'un projet, qui aurait pour but de convertir ces déchets organiques en un produit d'alimentation de haute qualité pour le bétail/compost? (encercler) *Would you be interested in joining a project attempting to convert this organic waste into a high quality animal feed/compost? (please circle)*

   OUI/*YES* NON/*NO*

6. Si vous êtes intéressé, seriez vous prêt a garantir la séparation des déchets alimentaire vs. des déchets d'emballage? (encercler) *If you are interested, would you be further willing to guarantee us proper separation of food, waste vs. packaging material (plastic,paper etc)? (please circle)*

   OUI/*YES* NON/*NO*

7. Commentaires/*Comments*:
   ....
   ....

PRIERE DE RETOURNER PAR FAX/PLEASE REPLY BY FAX - (514) 398-7964

APPENDIX B

Abbreviations:

Experiment 1.

Growth performance:

- E : experiment
- T : treatment
- B : block
- R : replicate
- # : identification number
- S : sex
- W0 - 49 : body weight at one, 7, 14, 21, 28, 35, 42, and 49 days of age
- BWG : body weight gain
- ADG : average daily gain

Feed consumption:

- E : experiment
- T : treatment
- B : block
- R : replicate
- W1 - 49 : body weight at one, 7, 14, 21, 28, 35, 42, and 49 days of age
- FC : feed consumption
- CFC : cumulative feed consumption
- FCR : feed conversion ratio

Experiment 2.

Growth performance:

- E : experiment
- T : treatment
- B : block
- R : replicate
- # : identification number
- S : sex
- W1 - 49 : body weight at one, 14, 21, 35, and 49 days of age
- BWG : body weight gain
- ADG : average daily gain

Feed consumption:

- E : experiment
- T : treatment
- B : block
- R : replicate
- W1 - 49 : body weight at one, 14, 21, 35, and 49 days of age
- FC : feed consumption
- CFC : cumulative feed consumption
- FCR : feed conversion ratio

EXPERIMENT 1 : Feed consumption and conversion on DM basis

E	T	B	R	W1	W7	W14	W21	W28	W35	W42	W49	FC7	FC14	FC21	FC28	FC35	FC42	FC49	CFC 14-49d	FCR 14-49d	CFC 0-49d	FCR 0-49d
1	1	1	1	56	251	681	1153	1695	2283	2728	3102	222	745	858	984	1249	1436	1437	5964	2.46	6931	2.28
1	1	1	2	56	238	666	1185	1788	2367	2978	3198	222	745	819	1063	1266	1393	1587	6128	2.42	7095	2.26
1	1	2	1	56	266	744	1301	1867	2463	3016	3247	222	745	898	1110	1289	1501	1517	6315	2.52	7282	2.28
1	1	2	2	56	265	746	1283	1835	2481	2984	3170	222	745	879	1243	1274	1431	1529	6356	2.62	7323	2.35
1	2	1	1	56	234	649	1189	1735	2319	2744	2898	229	764	906	1082	1334	1427	1353	6102	2.71	7095	2.50
1	2	1	2	56	241	699	1172	1752	2373	2938	3175	229	764	729	1229	1466	1650	1744	6818	2.75	7811	2.50
1	2	2	1	56	259	717	1311	1894	2547	3035	3195	229	764	971	1049	1578	1727	1495	6820	2.75	7813	2.49
1	2	2	2	56	275	775	1313	1892	2530	3070	3313	229	764	905	1134	1401	1563	1631	6634	2.61	7627	2.34
1	3	1	1	56	233	643	1084	1553	2112	2654	2940	211	751	848	1097	1368	1624	1453	6390	2.78	7352	2.55
1	3	1	2	56	245	688	1084	1584	2153	2560	2887	211	751	874	1107	1327	1405	1422	6135	2.79	7097	2.51
1	3	2	1	56	266	758	1208	1720	2330	2813	3113	211	751	945	1159	1433	1601	1584	6722	2.85	7684	2.51
1	3	2	2	56	258	738	1214	1764	2370	2891	3224	211	751	913	1206	1480	1681	1693	6973	2.80	7935	2.50
1	4	1	1	56	235	646	1082	1611	2202	2672	3048	230	765	863	1166	1400	1420	1376	6225	2.59	7220	2.41
1	4	1	2	56	239	683	1112	1645	2228	2738	3179	230	765	916	1246	1424	1487	1467	6540	2.62	7535	2.41
1	4	2	1	56	270	734	1215	1792	2402	2951	3434	230	765	1020	1261	1492	1547	1401	6721	2.49	7716	2.28
1	4	2	2	56	265	778	1259	1830	2538	3126	3619	230	765	1050	1300	1516	1655	1590	7111	2.50	8106	2.28
1	5	1	1	56	235	663	1080	1615	2182	2708	3155	225	766	917	1117	1403	1450	1361	6248	2.51	7239	2.34
1	5	1	2	56	233	640	1069	1635	2254	2694	3272	225	766	956	1233	1445	1636	1694	6964	2.65	7955	2.47
1	5	2	1	56	265	734	1178	1689	2261	2762	3098	225	766	916	1172	1393	1438	1338	6257	2.65	7248	2.38
1	5	2	2	56	276	791	1171	1642	2211	2676	2979	225	766	1009	1121	1306	1341	1259	6036	2.76	7027	2.40
1	6	1	1	56	236	649	1106	1592	2155	2688	3063	227	753	983	1173	1349	1510	1416	6431	2.66	7411	2.46
1	6	1	2	56	240	672	1154	1688	2307	2791	3178	227	753	1074	1276	1469	1530	1413	6762	2.70	7742	2.48
1	6	2	1	56	269	779	1243	1787	2341	2801	3137	227	753	1016	1285	1490	1580	1319	6690	2.84	7670	2.49
1	6	2	2	56	266	752	1271	1852	2522	2789	3476	227	753	1094	1221	1703	1725	1555	7298	2.68	8278	2.42

EXPERIMENT 1: Growth performance of Pekin ducks fed 6 diets including a 100% food waste diet (treatment 6)																	
														BWG	ADG	BWG	ADG
E	T	B	R	#	S	W0	W7	W14	W21	W28	W35	W42	W49	0-49D	0-49D	14-49D	14-49D
1	1	1	1	3	1	56	293	688	1035	1605	2212	2735	2870	2814	57.43	2182	311.71
1	1	1	1	5	1	56	276	706	1116	1605	2186	2847	3025	2969	60.59	2319	331.29
1	1	1	1	6	1	56	248	656	1005	1542	2139	2664	2790	2734	55.80	2134	304.86
1	1	1	1	7	1	56	242	661	1134	1591	2136	2736	3046	2990	61.02	2385	340.71
1	1	1	1	9	1	56	267	688	1150	1613	2227	2724	2990	2934	59.88	2302	328.86
1	1	1	1	10	1	56	260	678	1162	1728	2359	2936	3340	3284	67.02	2662	380.29
1	1	1	1	11	1	56	246	672	1145	1678	2252	2798	2976	2920	59.59	2304	329.14
1	1	1	1	13	1	56	223	623	1082	1705	2310	2818	3095	3039	62.02	2472	353.14
1	1	1	1	14	1	56	242	696	1172	1710	2320	2734	2950	2894	59.06	2254	322.00
1	1	1	1	15	1	56	263	656	1099	1562	2059	2565	2805	2749	56.10	2149	307.00
1	1	1	1	18	1	56	240	725	1168	1721	2334	2906	2968	2912	59.43	2243	320.43
1	1	1	1	22	1	56	283	696	1146	1784	2407	2874	3185	3129	63.86	2489	355.57
1	1	1	1	25	1	56	272	663	1124	1642	2189	2735	2935	2879	58.76	2272	324.57
1	1	1	1	1	2	56	245	659	1075	1510	1975	2538	2968	2912	59.43	2309	329.86
1	1	1	1	2	2	56	270	694	1214	1705	2415	3043	3142	3086	62.98	2448	349.71
1	1	1	1	4	2	56	252	700	1245	1684	2363	2671	2795	2739	55.90	2095	299.29
1	1	1	1	8	2	56	298	676	1232	1848	2355	3085	3195	3139	64.06	2519	359.86
1	1	1	1	12	2	56	267	713	1205	1744	2385	2905	3078	3022	61.67	2365	337.86
1	1	1	1	16	2	56	217	624	1109	1666	2254	2909	3290	3234	66.00	2666	380.86
1	1	1	1	17	2	56	264	728	1182	1796	2362	3135	3380	3324	67.84	2652	378.86
1	1	1	1	19	2	56	252	705	1285	1905	2508	3236	3670	3614	73.76	2965	423.57
1	1	1	1	20	2	56	247	688	1235	1822	2322	2921	3240	3184	64.98	2552	364.57
1	1	1	1	21	2	56	350	696	1175	1812	2409	3154	3440	3384	69.06	2744	392.00
1	1	1	1	24	2	56	220	615	1083	1625	2225	2945	3268	3212	65.55	2653	379.00
1	1	1	1	26	2	56	266	699	1132	1605	2154	2732	3110	3054	62.33	2411	344.43
1	1	1	2	27	1	56	246	627	1182	1792	2392	2955	3120	3064	62.53	2493	356.14
1	1	1	2	28	1	56	241	629	1236	1866	2395	2858	2998	2942	60.04	2369	338.43
1	1	1	2	30	1	56	226	674	1266	1905	2540	3146	3209	3153	64.35	2535	362.14
1	1	1	2	31	1	56	263	673	1188	1788	2377	2906	3125	3069	62.63	2452	350.29
1	1	1	2	32	1	56	201	647	1190	1823	2410	2877	3141	3085	62.96	2494	356.29
1	1	1	2	34	1	56	223	600	1120	1738	2322	2875	2978	2922	59.63	2378	339.71
1	1	1	2	35	1	56	245	675	1265	2006	2706	3264	3525	3469	70.80	2850	407.14
1	1	1	2	40	1	56	247	709	1274	1922	2604	3026	3209	3153	64.35	2500	357.14

1	1	1	2	42	1	56	281	705	1194	1736	2195	2607	2725	2669	54.47	2020	288.57
1	1	1	2	44	1	56	255	698	1174	1814	2412	2936	3196	3140	64.08	2498	356.86
1	1	1	2	45	1	56	240	670	1205	1725	2211	2936	3152	3096	63.18	2482	354.57
1	1	1	2	46	1	56	270	681	1167	1707	2342	2926	3205	3149	64.27	2524	360.57
1	1	1	2	47	1	56	226	616	1177	1742	2365	2871	3137	3081	62.88	2521	360.14
1	1	1	2	48	1	56	221	645	1202	1825	2400	2794	2882	2826	57.67	2237	319.57
1	1	1	2	29	2	56	224	670	1324	2095	2790	3482	3756	3700	75.51	3086	440.86
1	1	1	2	33	2	56	148	503	1047	1768	2504	3072	2905	2849	58.14	2402	343.14
1	1	1	2	36	2	56	249	706	1262	1853	2455	3026	3498	3442	70.24	2792	398.86
1	1	1	2	39	2	56	252	726	1272	1973	2585	3092	3409	3353	68.43	2683	383.29
1	1	1	2	41	2	56	219	625	1115	1752	2326	2884	3296	3240	66.12	2671	381.57
1	1	1	2	43	2	56	267	735	1304	1938	2534	3036	3490	3434	70.08	2755	393.57
1	1	2	1	50	1	56	256	698	1205	1717	2287	2667	2866	2810	57.35	2168	309.71
1	1	2	1	51	1	56	282	809	1392	1975	2675	3267	3378	3322	67.80	2569	367.00
1	1	2	1	53	1	56	264	753	1298	1875	2367	2818	2655	2599	53.04	1902	271.71
1	1	2	1	57	1	56	245	735	1304	1842	2386	3081	3408	3352	68.41	2673	381.86
1	1	2	1	61	1	56	242	695	1256	1830	2435	2775	3159	3103	63.33	2464	352.00
1	1	2	1	62	1	56	225	703	1216	1667	2148	2711	2991	2935	59.90	2288	326.86
1	1	2	1	63	1	56	283	695	1295	1790	2374	2941	3144	3088	63.02	2449	349.86
1	1	2	1	64	1	56	293	788	1328	1854	2535	2963	3027	2971	60.63	2239	319.86
1	1	2	1	65	1	56	271	763	1304	1939	2645	3260	3762	3706	75.63	2999	428.43
1	1	2	1	67	1	56	272	731	1280	1775	2056	2404	2254	2198	44.86	1523	217.57
1	1	2	1	69	1	56	269	757	1337	1897	2464	2967	3125	3069	62.63	2368	338.29
1	1	2	1	72	1	56	235	696	1230	1846	2436	2923	3019	2963	60.47	2323	331.86
1	1	2	1	49	2	56	255	722	1178	1725	2265	2762	2997	2941	60.02	2275	325.00
1	1	2	1	52	2	56	253	757	1338	1846	2564	3113	3392	3336	68.08	2635	376.43
1	1	2	1	54	2	56	260	722	1250	1842	2473	3065	3281	3225	65.82	2559	365.57
1	1	2	1	55	2	56	272	773	1283	1807	2376	3079	3508	3452	70.45	2735	390.71
1	1	2	1	56	2	56	274	744	1385	1918	2534	3149	3287	3231	65.94	2543	363.29
1	1	2	1	59	2	56	252	751	1312	1952	2577	3238	3357	3301	67.37	2606	372.29
1	1	2	1	60	2	56	270	700	1340	2030	2735	3455	3819	3763	76.80	3119	445.57
1	1	2	1	66	2	56	294	798	1368	1922	2656	3309	3902	3846	78.49	3104	443.43
1	1	2	1	68	2	56	282	788	1400	1964	2539	3200	3455	3399	69.37	2667	381.00
1	1	2	1	70	2	56	298	763	1349	1959	2608	3182	3677	3621	73.90	2914	416.29
1	1	2	1	71	2	56	281	777	1360	1965	2517	3045	3226	3170	64.69	2449	349.86
1	1	2	2	73	1	56	250	732	1215	1625	2207	2625	2633	2577	52.59	1901	271.57

1	1	2	2	75	1	56	268	768	1244	1820	2468	2952	3092	3036	61.96	2324	332.00
1	1	2	2	78	1	56	270	795	1422	1978	2605	3027	3045	2989	61.00	2250	321.43
1	1	2	2	79	1	56	253	763	1300	1872	2509	3057	3284	3228	65.88	2521	360.14
1	1	2	2	81	1	56	276	746	1235	1907	2703	3279	3478	3422	69.84	2732	390.29
1	1	2	2	83	1	56	258	768	1246	1767	2374	2887	3153	3097	63.20	2385	340.71
1	1	2	2	85	1	56	277	793	1432	2060	2733	3285	3266	3210	65.51	2473	353.29
1	1	2	2	92	1	56	246	699	1230	1773	2486	2960	3196	3140	64.08	2497	356.71
1	1	2	2	93	1	56	257	762	1381	1970	2647	3131	3394	3338	68.12	2632	376.00
1	1	2	2	94	1	56	256	744	1275	1887	2534	2509	2909	2853	58.22	2165	309.29
1	1	2	2	95	1	56	255	754	1195	1707	2286	2702	2940	2884	58.86	2186	312.29
1	1	2	2	96	1	56	270	700	1159	1679	2214	2755	2969	2913	59.45	2269	324.14
1	1	2	2	74	2	56	248	736	1306	1865	2608	3302	3659	3603	73.53	2923	417.57
1	1	2	2	76	2	56	289	726	1155	1795	2484	2981	3211	3155	64.39	2485	355.00
1	1	2	2	77	2	56	260	752	1335	1822	2462	3008	3190	3134	63.96	2438	348.29
1	1	2	2	80	2	56	306	750	1260	1806	2428	2888	2976	2920	59.59	2226	318.00
1	1	2	2	82	2	56	272	742	1310	1906	2545	3067	3191	3135	63.98	2449	349.86
1	1	2	2	84	2	56	267	757	1335	1997	2676	3260	3456	3400	69.39	2699	385.57
1	1	2	2	86	2	56	244	739	1310	1769	2370	2996	3046	2990	61.02	2307	329.57
1	1	2	2	87	2	56	248	695	1200	1694	2309	2911	3065	3009	61.41	2370	338.57
1	1	2	2	88	2	56	269	753	1320	1905	2524	3074	3316	3260	66.53	2563	366.14
1	1	2	2	89	2	56	253	730	1230	1686	2282	2755	3058	3002	61.27	2328	332.57
1	1	2	2	90	2	56	261	720	1340	1803	2374	2874	3096	3040	62.04	2376	339.43
1	1	2	2	91	2	56	295	766	1350	1908	2595	3121	3159	3103	63.33	2393	341.86
1	1	2	2	97	2	56	278	749	1302	1862	2614	3191	3464	3408	69.55	2715	387.86
1	2	1	1	2	1	56	250	640	1165	1776	2323	2707	2710	2654	54.16	2070	295.71
1	2	1	1	10	1	56	222	576	1100	1597	2153	2753	2884	2828	57.71	2308	329.71
1	2	1	1	12	1	56	236	644	1185	1689	2203	2451	2681	2625	53.57	2037	291.00
1	2	1	1	13	1	56	189	557	1075	1625	2242	2568	2566	2510	51.22	2009	287.00
1	2	1	1	14	1	56	236	642	1164	1507	2166	2783	2886	2830	57.76	2244	320.57
1	2	1	1	16	1	56	229	679	1195	1723	2357	2811	3126	3070	62.65	2447	349.57
1	2	1	1	17	1	56	217	636	1173	1667	2292	2545	2616	2560	52.24	1980	282.86
1	2	1	1	18	1	56	250	672	1212	1723	2446	2406	2566	2510	51.22	1894	270.57
1	2	1	1	19	1	56	239	656	1185	1769	2360	2815	3078	3022	61.67	2422	346.00
1	2	1	1	22	1	56	274	683	1206	1775	2363	2763	2968	2912	59.43	2285	326.43
1	2	1	1	23	1	56	229	635	1185	1782	2387	2979	3134	3078	62.82	2499	357.00
1	2	1	1	24	1	56	240	610	1019	1522	2130	2513	2809	2753	56.18	2199	314.14

1	2	1	1	1	2	56	217	688	1180	1608	2025	2236	2446	2390	48.78	1758	251.14
1	2	1	1	3	2	56	247	683	1197	1723	2205	2444	2473	2417	49.33	1790	255.71
1	2	1	1	4	2	56	185	570	1085	1629	2306	2912	3306	3250	66.33	2736	390.86
1	2	1	1	6	2	56	245	699	1285	1862	2465	3075	3349	3293	67.20	2650	378.57
1	2	1	1	7	2	56	264	703	1275	1886	2576	3168	3488	3432	70.04	2785	397.86
1	2	1	1	8	2	56	275	703	1310	1828	2345	2762	2710	2654	54.16	2007	286.71
1	2	1	1	9	2	56	263	686	1239	1719	2370	2734	3021	2965	60.51	2335	333.57
1	2	1	1	11	2	56	218	560	1049	1571	2028	2487	2686	2630	53.67	2126	303.71
1	2	1	1	15	2	56	203	612	1187	1728	2378	3018	2861	2805	57.24	2249	321.29
1	2	1	1	20	2	56	253	701	1350	1977	2656	3144	3286	3230	65.92	2585	369.29
1	2	1	1	21	2	56	267	695	1315	1925	2565	3033	3013	2957	60.35	2318	331.14
1	2	1	2	29	1	56	252	698	1186	1762	2442	2979	3114	3058	62.41	2416	345.14
1	2	1	2	32	1	56	198	629	1092	1645	2166	2735	2986	2930	59.80	2357	336.71
1	2	1	2	35	1	56	204	689	1169	1707	2240	2654	2880	2824	57.63	2191	313.00
1	2	1	2	36	1	56	262	698	1117	1659	2245	2704	2986	2930	59.80	2288	326.86
1	2	1	2	38	1	56	223	662	1142	1574	2275	2715	2707	2651	54.10	2045	292.14
1	2	1	2	39	1	56	212	626	1076	1646	2242	2756	2738	2682	54.73	2112	301.71
1	2	1	2	43	1	56	248	700	1115	1656	2382	2867	3146	3090	63.06	2446	349.43
1	2	1	2	44	1	56	223	719	1307	1942	2564	3128	3350	3294	67.22	2631	375.86
1	2	1	2	45	1	56	259	750	1192	1764	2373	2839	2660	2604	53.14	1910	272.86
1	2	1	2	47	1	56	236	686	1090	1619	2182	2808	3090	3034	61.92	2404	343.43
1	2	1	2	48	1	56	268	743	1228	1796	2385	2825	2845	2789	56.92	2102	300.29
1	2	1	2	49	1	56	275	752	1193	1727	2382	2946	3118	3062	62.49	2366	338.00
1	2	1	2	25	2	56	251	722	1147	1758	2356	2918	3160	3104	63.35	2438	348.29
1	2	1	2	26	2	56	262	711	1232	1908	2542	3172	3468	3412	69.63	2757	393.86
1	2	1	2	27	2	56	253	753	1305	2025	2775	3582	3856	3800	77.55	3103	443.29
1	2	1	2	28	2	56	235	695	1178	1708	2370	3037	3460	3404	69.47	2765	395.00
1	2	1	2	30	2	56	261	721	1160	1692	2260	2804	3298	3242	66.16	2577	368.14
1	2	1	2	33	2	56	243	720	1245	1924	2532	3065	3294	3238	66.08	2574	367.71
1	2	1	2	34	2	56	229	709	1167	1738	2320	2873	3206	3150	64.29	2497	356.71
1	2	1	2	37	2	56	214	669	1158	1692	2342	2872	3205	3149	64.27	2536	362.29
1	2	1	2	40	2	56	225	667	1210	1863	2475	3109	3510	3454	70.49	2843	406.14
1	2	1	2	41	2	56	263	703	1160	1728	2376	3008	3310	3254	66.41	2607	372.43
1	2	1	2	42	2	56	239	665	1038	1666	2220	2787	3046	2990	61.02	2381	340.14
1	2	1	2	46	2	56	239	692	1208	1814	2530	3225	3760	3704	75.59	3068	438.29
1	2	2	1	51	1	56	265	683	1188	1706	2239	2724	2960	2904	59.27	2277	325.29

1	2	2	1	52	1	56	254	721	1372	1985	2618	2887	2950	2894	59.06	2229	318.43
1	2	2	1	53	1	56	292	775	1377	2015	2642	3215	3170	3114	63.55	2395	342.14
1	2	2	1	54	1	56	237	704	1234	1764	2465	2972	3274	3218	65.67	2570	367.14
1	2	2	1	56	1	56	261	683	1266	1835	2433	2856	3066	3010	61.43	2383	340.43
1	2	2	1	57	1	56	266	672	1220	1820	2412	2931	2968	2912	59.43	2296	328.00
1	2	2	1	61	1	56	248	704	1275	1865	2506	3045	3260	3204	65.39	2556	365.14
1	2	2	1	63	1	56	276	752	1404	1945	2601	2911	3094	3038	62.00	2342	334.57
1	2	2	1	65	1	56	261	724	1335	1942	2577	2976	3268	3212	65.55	2544	363.43
1	2	2	1	66	1	56	237	692	1244	1803	2402	2787	2860	2804	57.22	2168	309.71
1	2	2	1	72	1	56	273	747	1384	1916	2660	3136	3260	3204	65.39	2513	359.00
1	2	2	1	73	1	56	278	735	1371	1995	2487	3018	3207	3151	64.31	2472	353.14
1	2	2	1	74	1	56	252	683	1274	1852	2369	2785	2995	2939	59.98	2312	330.29
1	2	2	1	50	2	56	238	713	1282	1874	2552	3117	3350	3294	67.22	2637	376.71
1	2	2	1	58	2	56	247	672	1234	1742	2447	2958	3105	3049	62.22	2433	347.57
1	2	2	1	59	2	56	260	699	1268	1845	2581	3136	3385	3329	67.94	2686	383.71
1	2	2	1	60	2	56	256	733	1325	1936	2647	3236	3448	3392	69.22	2715	387.86
1	2	2	1	62	2	56	249	712	1355	1962	2561	3155	3398	3342	68.20	2686	383.71
1	2	2	1	64	2	56	257	705	1286	1878	2506	3075	3268	3212	65.55	2563	366.14
1	2	2	1	68	2	56	253	701	1264	1882	2591	3220	3268	3212	65.55	2567	366.71
1	2	2	1	69	2	56	265	770	1412	2005	2637	3269	3340	3284	67.02	2570	367.14
1	2	2	1	70	2	56	282	780	1363	1928	2713	3144	3340	3284	67.02	2560	365.71
1	2	2	1	71	2	56	252	692	1234	1845	2452	3042	3260	3204	65.39	2568	366.86
1	2	2	2	75	1	56	254	727	1215	1738	2318	2790	2904	2848	58.12	2177	311.00
1	2	2	2	76	1	56	255	796	1345	1908	2495	2884	3013	2957	60.35	2217	316.71
1	2	2	2	79	1	56	275	783	1338	1753	2357	2795	3028	2972	60.65	2245	320.71
1	2	2	2	80	1	56	269	756	1309	1962	2736	3405	3630	3574	72.94	2874	410.57
1	2	2	2	85	1	56	291	792	1264	1805	2427	2975	3085	3029	61.82	2293	327.57
1	2	2	2	86	1	56	242	734	1217	1733	2296	2825	3053	2997	61.16	2319	331.29
1	2	2	2	88	1	56	310	805	1435	2113	2739	3208	3435	3379	68.96	2630	375.71
1	2	2	2	90	1	56	279	762	1226	1647	2351	2903	3080	3024	61.71	2318	331.14
1	2	2	2	91	1	56	285	766	1241	1756	2379	2856	3098	3042	62.08	2332	333.14
1	2	2	2	92	1	56	268	780	1392	1874	2459	2952	3208	3152	64.33	2428	346.86
1	2	2	2	93	1	56	293	835	1358	1953	2642	3107	3280	3224	65.80	2445	349.29
1	2	2	2	94	1	56	291	790	1387	1956	2628	3182	3335	3279	66.92	2545	363.57
1	2	2	2	97	1	56	295	756	1266	1862	2403	2978	3035	2979	60.80	2279	325.57
1	2	2	2	77	2	56	233	739	1367	1978	2607	3156	3296	3240	66.12	2557	365.29

1	2	2	2	78	2	56	250	743	1305	1922	2554	3160	3546	3490	71.22	2803	400.43
1	2	2	2	81	2	56	275	758	1292	1805	2557	3245	3695	3639	74.27	2937	419.57
1	2	2	2	82	2	56	263	776	1285	2016	2671	3265	3098	3042	62.08	2322	331.71
1	2	2	2	83	2	56	283	750	1405	1971	2559	3064	3360	3304	67.43	2610	372.86
1	2	2	2	84	2	56	254	757	1307	1975	2697	3339	3609	3553	72.51	2852	407.43
1	2	2	2	87	2	56	242	722	1145	1799	2456	3101	3460	3404	69.47	2738	391.14
1	2	2	2	89	2	56	273	798	1224	1912	2544	3087	3505	3449	70.39	2707	386.71
1	2	2	2	95	2	56	308	810	1305	1844	2338	2740	3195	3139	64.06	2385	340.71
1	2	2	2	96	2	56	304	883	1475	2035	2660	3136	3406	3350	68.37	2523	360.43
1	2	2	2	98	2	56	278	803	1381	2024	2727	3162	3538	3482	71.06	2735	390.71
1	2	2	2	99	2	56	280	788	1395	1954	2589	3207	3470	3414	69.67	2682	383.14
1	2	2	2	100	2	56	292	752	1266	1896	2601	3286	3788	3732	76.16	3036	433.71
1	3	1	1	5	1	56	242	672	1103	1544	2253	2762	3006	2950	60.20	2334	333.43
1	3	1	1	7	1	56	253	662	1116	1638	2216	2903	2872	2816	57.47	2210	315.71
1	3	1	1	10	1	56	217	538	987	1501	2054	1815	1442	1386	28.29	904	129.14
1	3	1	1	18	1	56	252	690	1117	1523	1997	2333	2553	2497	50.96	1863	266.14
1	3	1	1	19	1	56	258	677	1118	1655	2281	2754	2805	2749	56.10	2128	304.00
1	3	1	1	21	1	56	211	588	1025	1457	2042	2519	2796	2740	55.92	2208	315.43
1	3	1	1	1	2	56	240	646	1084	1495	2226	2783	3198	3142	64.12	2552	364.57
1	3	1	1	2	2	56	243	668	1105	1536	2268	2847	3298	3242	66.16	2630	375.71
1	3	1	1	4	2	56	224	672	1116	1598	2118	2433	2540	2484	50.69	1868	266.86
1	3	1	1	6	2	56	225	643	1095	1623	2220	2776	3123	3067	62.59	2480	354.29
1	3	1	1	8	2	56	218	659	1138	1634	2352	2803	4172	4116	84.00	3513	501.86
1	3	1	1	9	2	56	219	645	1128	1563	1629	2324	2590	2534	51.71	1945	277.86
1	3	1	1	11	2	56	242	695	1207	1726	2349	2853	3250	3194	65.18	2555	365.00
1	3	1	1	12	2	56	270	708	1287	1907	2637	3291	3565	3509	71.61	2857	408.14
1	3	1	1	14	2	56	226	619	1022	1486	2027	2497	2891	2835	57.86	2272	324.57
1	3	1	1	15	2	56	179	520	925	1473	2119	2678	2885	2829	57.73	2365	337.86
1	3	1	1	16	2	56	257	707	1077	1553	2156	2793	3090	3034	61.92	2383	340.43
1	3	1	1	17	2	56	240	682	1205	1711	2282	2845	3125	3069	62.63	2443	349.00
1	3	1	1	20	2	56	262	684	1186	1738	2298	2824	3077	3021	61.65	2393	341.86
1	3	1	1	22	2	56	207	577	1013	1518	2090	2515	2828	2772	56.57	2251	321.57
1	3	1	1	23	2	56	239	660	1025	1301	1834	2294	2679	2623	53.53	2019	288.43
1	3	1	1	24	2	56	224	610	1003	1453	2035	2628	2840	2784	56.82	2230	318.57
1	3	1	1	25	2	56	215	620	1062	1630	2254	2763	3005	2949	60.18	2385	340.71
1	3	1	2	27	1	56	247	710	1175	1616	2176	2732	3069	3013	61.49	2359	337.00

1	3	1	2	29	1	56	226	675	1058	1496	2040	2469	2572	2516	51.35	1897	271.00
1	3	1	2	30	1	56	220	652	1100	1578	2095	2476	2626	2570	52.45	1974	282.00
1	3	1	2	33	1	56	239	718	1160	1673	2282	2749	3062	3006	61.35	2344	334.86
1	3	1	2	34	1	56	248	724	1032	1579	2205	2679	3039	2983	60.88	2315	330.71
1	3	1	2	35	1	56	241	722	1145	1668	2242	2582	2636	2580	52.65	1914	273.43
1	3	1	2	37	1	56	244	721	1115	1584	2086	2483	2663	2607	53.20	1942	277.43
1	3	1	2	38	1	56	276	688	1090	1567	2108	2573	2890	2834	57.84	2202	314.57
1	3	1	2	39	1	56	267	701	1115	1632	2226	2693	2856	2800	57.14	2155	307.86
1	3	1	2	41	1	56	247	675	1055	1496	1975	2253	2539	2483	50.67	1864	266.29
1	3	1	2	43	1	56	254	707	1098	1585	2084	2389	2563	2507	51.16	1856	265.14
1	3	1	2	46	1	56	227	646	1132	1644	2145	2543	2864	2808	57.31	2218	316.86
1	3	1	2	47	1	56	291	750	1268	1808	2420	2891	3241	3185	65.00	2491	355.86
1	3	1	2	26	2	56	239	696	770	1353	2008	2539	2951	2895	59.08	2255	322.14
1	3	1	2	28	2	56	245	661	1055	1590	2196	2359	3096	3040	62.04	2435	347.86
1	3	1	2	31	2	56	228	714	1130	1692	2382	2953	3366	3310	67.55	2652	378.86
1	3	1	2	32	2	56	208	631	1030	1524	2092	2658	3069	3013	61.49	2438	348.29
1	3	1	2	36	2	56	278	710	1125	1625	2136	2437	2844	2788	56.90	2134	304.86
1	3	1	2	40	2	56	237	696	1168	1677	2228	2732	3135	3079	62.84	2439	348.43
1	3	1	2	42	2	56	250	671	1033	1490	2086	2370	3002	2946	60.12	2331	333.00
1	3	1	2	44	2	56	280	693	1045	1565	2163	2564	2971	2915	59.49	2278	325.43
1	3	1	2	45	2	56	225	675	1125	1680	2286	2771	3216	3160	64.49	2541	363.00
1	3	1	2	48	2	56	214	622	1015	1497	2103	2291	2411	2355	48.06	1789	255.57
1	3	1	2	49	2	56	242	642	979	1407	1905	2251	2612	2556	52.16	1970	281.43
1	3	2	1	50	1	56	255	726	1148	1634	2286	2776	2878	2822	57.59	2152	307.43
1	3	2	1	51	1	56	268	795	1305	1912	2613	3084	3490	3434	70.08	2695	385.00
1	3	2	1	53	1	56	283	779	1220	1629	2342	2738	2970	2914	59.47	2191	313.00
1	3	2	1	54	1	56	254	734	1205	1692	2364	2903	3116	3060	62.45	2382	340.29
1	3	2	1	56	1	56	281	776	1255	1795	2483	2875	3089	3033	61.90	2313	330.43
1	3	2	1	57	1	56	268	730	1184	1685	2358	2807	3035	2979	60.80	2305	329.29
1	3	2	1	59	1	56	230	718	1145	1620	2225	2756	3095	3039	62.02	2379	339.86
1	3	2	1	61	1	56	293	776	1226	1780	2456	2938	3206	3150	64.29	2430	347.14
1	3	2	1	62	1	56	246	692	1145	1522	2135	2630	2959	2903	59.24	2267	323.86
1	3	2	1	65	1	56	261	774	1264	1821	2545	3086	3360	3304	67.43	2586	369.43
1	3	2	1	67	1	56	253	762	1236	1745	2297	2835	3058	3002	61.27	2296	328.00
1	3	2	1	70	1	56	278	725	1093	1462	1940	2408	2730	2674	54.57	2005	286.43
1	3	2	1	71	1	56	270	751	1244	1656	2272	2703	2879	2823	57.61	2128	304.00

1	3	2	1	75	1	56	284	749	1258	1817	2351	2614	2845	2789	56.92	2096	299.43
1	3	2	1	55	2	56	266	750	1090	1548	2031	2386	2789	2733	55.78	2039	291.29
1	3	2	1	58	2	56	236	773	1229	1844	2440	2925	3068	3012	61.47	2295	327.86
1	3	2	1	60	2	56	286	789	1235	1805	2369	2787	3109	3053	62.31	2320	331.43
1	3	2	1	63	2	56	252	749	1178	1798	2278	2735	3099	3043	62.10	2350	335.71
1	3	2	1	64	2	56	255	736	1270	1844	2453	3026	3387	3331	67.98	2651	378.71
1	3	2	1	66	2	56	266	795	1266	1738	2238	2818	3180	3124	63.76	2385	340.71
1	3	2	1	68	2	56	279	750	1103	1578	2057	2555	2961	2905	59.29	2211	315.86
1	3	2	1	69	2	56	280	830	1265	1793	2435	2938	3268	3212	65.55	2438	348.29
1	3	2	1	72	2	56	254	724	1152	1735	2513	3142	3653	3597	73.41	2929	418.43
1	3	2	1	73	2	56	291	765	1195	1677	2245	2720	2995	2939	59.98	2230	318.57
1	3	2	1	74	2	56	245	790	1275	1844	2472	3104	3604	3548	72.41	2814	402.00
1	3	2	2	76	1	56	256	705	1095	1637	2185	2711	3105	3049	62.22	2400	342.86
1	3	2	2	77	1	56	243	746	1280	1902	2642	3157	3515	3459	70.59	2769	395.57
1	3	2	2	78	1	56	260	751	1235	1775	2276	2719	3011	2955	60.31	2260	322.86
1	3	2	2	82	1	56	249	686	1145	1665	2308	2680	2942	2886	58.90	2256	322.29
1	3	2	2	83	1	56	267	685	1170	1657	2376	2890	3318	3262	66.57	2633	376.14
1	3	2	2	84	1	56	267	790	1236	1734	2305	2760	3108	3052	62.29	2318	331.14
1	3	2	2	88	1	56	255	750	1208	1715	2388	2887	3221	3165	64.59	2471	353.00
1	3	2	2	89	1	56	251	736	1310	1965	2648	3353	3616	3560	72.65	2880	411.43
1	3	2	2	92	1	56	280	738	1205	1709	2298	2731	3045	2989	61.00	2307	329.57
1	3	2	2	94	1	56	266	773	1250	1806	2478	3009	3257	3201	65.33	2484	354.86
1	3	2	2	95	1	56	265	767	1187	1597	2109	2456	2891	2835	57.86	2124	303.43
1	3	2	2	97	1	56	271	703	1184	1667	2115	2542	2948	2892	59.02	2245	320.71
1	3	2	2	99	1	56	242	710	1235	1820	2486	2919	3128	3072	62.69	2418	345.43
1	3	2	2	100	1	56	213	713	1148	1667	2192	2671	2963	2907	59.33	2250	321.43
1	3	2	2	79	2	56	277	756	1316	1930	2560	3175	3628	3572	72.90	2872	410.29
1	3	2	2	80	2	56	291	796	1285	1776	2316	2973	3265	3209	65.49	2469	352.71
1	3	2	2	81	2	56	241	717	1275	1869	2382	2823	3109	3053	62.31	2392	341.71
1	3	2	2	85	2	56	257	762	1265	1897	2445	3154	3492	3436	70.12	2730	390.00
1	3	2	2	86	2	56	254	714	1180	1668	2226	2841	3163	3107	63.41	2449	349.86
1	3	2	2	87	2	56	247	693	1240	1887	2654	3251	3713	3657	74.63	3020	431.43
1	3	2	2	90	2	56	268	750	1030	1480	2032	2542	3002	2946	60.12	2252	321.71
1	3	2	2	91	2	56	258	754	1164	1680	2211	2741	3088	3032	61.88	2334	333.43
1	3	2	2	93	2	56	279	802	1361	1980	2705	3359	3573	3517	71.78	2771	395.86
1	3	2	2	98	2	56	269	739	1230	1923	2692	3210	3585	3529	72.02	2846	406.57

1	3	2	2	101	2	56	259	735	1202	1712	2265	2716	2913	2857	58.31	2178	311.14
1	4	1	1	2	1	56	250	589	956	1436	2037	2558	3020	2964	60.49	2431	347.29
1	4	1	1	4	1	56	190	561	1025	1548	2136	2638	3070	3014	61.51	2509	358.43
1	4	1	1	5	1	56	227	643	1105	1705	2215	2745	3025	2969	60.59	2382	340.29
1	4	1	1	6	1	56	246	639	1066	1745	2393	3015	3550	3494	71.31	2911	415.86
1	4	1	1	7	1	56	254	705	1235	1820	2495	2912	3168	3112	63.51	2463	351.86
1	4	1	1	8	1	56	255	685	1076	1535	1980	2462	2920	2864	58.45	2235	319.29
1	4	1	1	9	1	56	249	673	1248	1828	2511	2808	3040	2984	60.90	2367	338.14
1	4	1	1	12	1	56	220	622	1036	1434	2191	2664	3170	3114	63.55	2548	364.00
1	4	1	1	13	1	56	245	676	1072	1524	2095	2468	2820	2764	56.41	2144	306.29
1	4	1	1	15	1	56	224	656	1044	1522	2043	2438	2783	2727	55.65	2127	303.86
1	4	1	1	16	1	56	262	564	916	1316	1934	2312	2720	2664	54.37	2156	308.00
1	4	1	1	18	1	56	258	662	1013	1548	2164	2462	2808	2752	56.16	2146	306.57
1	4	1	1	19	1	56	243	644	1115	1696	2370	2818	3098	3042	62.08	2454	350.57
1	4	1	1	24	1	56	240	644	1014	1507	2145	2570	2810	2754	56.20	2166	309.43
1	4	1	1	26	1	56	205	616	1116	1642	2252	2713	3166	3110	63.47	2550	364.29
1	4	1	1	1	2	56	218	606	1014	1453	2136	2630	3007	2951	60.22	2401	343.00
1	4	1	1	3	2	56	264	709	1209	1788	2370	2921	2969	2913	59.45	2260	322.86
1	4	1	1	10	2	56	242	660	1096	1652	2151	2758	3252	3196	65.22	2592	370.29
1	4	1	1	11	2	56	269	672	1113	1584	2195	2634	3010	2954	60.29	2338	334.00
1	4	1	1	14	2	56	215	656	1115	1775	2306	2824	3160	3104	63.35	2504	357.71
1	4	1	1	17	2	56	207	616	1028	1567	2129	2611	2990	2934	59.88	2374	339.14
1	4	1	1	20	2	56	211	656	1105	1632	2335	2945	3468	3412	69.63	2812	401.71
1	4	1	1	21	2	56	229	648	1039	1584	2148	2631	3098	3042	62.08	2450	350.00
1	4	1	1	22	2	56	252	695	1226	1855	2375	2808	3105	3049	62.22	2410	344.29
1	4	1	1	23	2	56	222	637	1066	1665	2184	2711	3268	3212	65.55	2631	375.86
1	4	1	1	25	2	56	222	666	1076	1528	1974	2409	2750	2694	54.98	2084	297.71
1	4	1	2	27	1	56	253	677	1148	1742	2256	2619	3196	3140	64.08	2519	359.86
1	4	1	2	28	1	56	238	670	1056	1529	2095	2635	3017	2961	60.43	2347	335.29
1	4	1	2	29	1	56	215	662	1122	1629	2219	2684	3251	3195	65.20	2589	369.86
1	4	1	2	30	1	56	239	701	1102	1706	2320	2854	3287	3231	65.94	2586	369.43
1	4	1	2	31	1	56	176	557	1029	1530	2108	2668	3087	3031	61.86	2530	361.43
1	4	1	2	32	1	56	243	704	1050	1548	2156	2643	3185	3129	63.86	2481	354.43
1	4	1	2	34	1	56	245	703	1145	1704	2278	2735	3148	3092	63.10	2445	349.29
1	4	1	2	36	1	56	218	644	1042	1603	2319	3068	3252	3196	65.22	2608	372.57
1	4	1	2	40	1	56	278	746	1142	1585	2151	2573	2963	2907	59.33	2217	316.71

1	4	1	2	41	1	56	258	705	1172	1762	2315	2735	3204	3148	64.24	2499	357.00
1	4	1	2	42	1	56	255	698	1076	1522	2076	2858	3303	3247	66.27	2605	372.14
1	4	1	2	43	1	56	255	738	1179	1745	2353	2935	3469	3413	69.65	2731	390.14
1	4	1	2	44	1	56	261	725	1152	1664	2372	2892	3256	3200	65.31	2531	361.57
1	4	1	2	45	1	56	273	741	1073	1596	2084	2717	2844	2788	56.90	2103	300.43
1	4	1	2	46	1	56	218	596	1038	1598	2186	2668	3322	3266	66.65	2726	389.43
1	4	1	2	48	1	56	258	765	1203	1692	2318	2856	3281	3225	65.82	2516	359.43
1	4	1	2	49	1	56	234	664	1156	1724	2275	2646	3104	3048	62.20	2440	348.57
1	4	1	2	50	1	56	233	660	962	1404	1848	2086	2507	2451	50.02	1847	263.86
1	4	1	2	51	1	56	211	619	1145	1736	2369	2708	3240	3184	64.98	2621	374.43
1	4	1	2	33	2	56	248	692	1153	1656	2224	2972	3203	3147	64.22	2511	358.71
1	4	1	2	35	2	56	183	600	972	1384	1911	2386	2983	2927	59.73	2383	340.43
1	4	1	2	37	2	56	250	718	1065	1621	2108	2603	3080	3024	61.71	2362	337.43
1	4	1	2	38	2	56	227	670	1154	1878	2547	3216	3497	3441	70.22	2827	403.86
1	4	1	2	47	2	56	268	738	1235	1782	2375	2945	3624	3568	72.82	2886	412.29
1	4	2	1	52	1	56	246	717	1225	1852	2464	3059	3585	3529	72.02	2868	409.71
1	4	2	1	56	1	56	265	760	1195	1628	2076	2410	2808	2752	56.16	2048	292.57
1	4	2	1	60	1	56	255	762	1320	1811	2384	2913	3215	3159	64.47	2453	350.43
1	4	2	1	63	1	56	252	744	1250	1779	2325	2861	3252	3196	65.22	2508	358.29
1	4	2	1	64	1	56	275	734	1230	1787	2545	3199	3602	3546	72.37	2868	409.71
1	4	2	1	68	1	56	276	753	1198	1924	2620	3478	4042	3986	81.35	3289	469.86
1	4	2	1	69	1	56	262	723	1126	1805	2433	2945	3342	3286	67.06	2619	374.14
1	4	2	1	71	1	56	266	761	1285	1896	2445	2860	3263	3207	65.45	2502	357.43
1	4	2	1	72	1	56	282	709	1165	1640	2251	2642	3173	3117	63.61	2464	352.00
1	4	2	1	73	1	56	282	736	1185	1757	2408	2875	3292	3236	66.04	2556	365.14
1	4	2	1	76	1	56	240	684	1175	1699	2294	2507	3045	2989	61.00	2361	337.29
1	4	2	1	53	2	56	266	676	1145	1773	2382	2991	3565	3509	71.61	2889	412.71
1	4	2	1	54	2	56	242	680	1131	1637	2276	2734	3285	3229	65.90	2605	372.14
1	4	2	1	55	2	56	274	766	1250	1854	2492	3155	3520	3464	70.69	2754	393.43
1	4	2	1	57	2	56	265	722	1232	1865	2428	2989	3366	3310	67.55	2644	377.71
1	4	2	1	58	2	56	244	711	1209	1768	2477	3184	3828	3772	76.98	3117	445.29
1	4	2	1	59	2	56	253	735	1145	1804	2484	3050	3637	3581	73.08	2902	414.57
1	4	2	1	61	2	56	275	771	1206	1834	2314	2987	3563	3507	71.57	2792	398.86
1	4	2	1	62	2	56	279	725	1105	1627	2185	2692	3397	3341	68.18	2672	381.71
1	4	2	1	65	2	56	300	800	1305	1915	2621	3315	3886	3830	78.16	3086	440.86
1	4	2	1	66	2	56	321	825	1285	1786	2265	2810	3205	3149	64.27	2380	340.00

1	4	2	1	67	2	56	355	709	1232	1946	2624	3215	3651	3595	73.37	2942	420.29
1	4	2	1	70	2	56	284	728	1186	1897	2544	3042	3502	3446	70.33	2774	396.29
1	4	2	1	74	2	56	259	728	1321	1866	2535	3015	3515	3459	70.59	2787	398.14
1	4	2	1	75	2	56	239	706	1168	1662	2184	2847	3299	3243	66.18	2593	370.43
1	4	2	2	78	1	56	242	739	1150	1672	2318	2944	3517	3461	70.63	2778	396.86
1	4	2	2	81	1	56	267	711	1176	1629	2272	2862	3550	3494	71.31	2839	405.57
1	4	2	2	82	1	56	253	717	1185	1707	2374	2793	3030	2974	60.69	2313	330.43
1	4	2	2	86	1	56	259	742	1270	1990	2732	3275	3636	3580	73.06	2894	413.43
1	4	2	2	90	1	56	263	743	1230	1807	2472	3108	3520	3464	70.69	2777	396.71
1	4	2	2	95	1	56	249	730	1076	1565	2124	2685	3237	3181	64.92	2507	358.14
1	4	2	2	96	1	56	272	763	1274	1888	2604	3152	3591	3535	72.14	2828	404.00
1	4	2	2	98	1	56	276	792	1296	1854	2564	3169	3592	3536	72.16	2800	400.00
1	4	2	2	100	1	56	265	785	1225	1796	2650	3201	3664	3608	73.63	2879	411.29
1	4	2	2	77	2	56	262	785	1259	1922	2843	3304	3956	3900	79.59	3171	453.00
1	4	2	2	79	2	56	251	761	1260	1856	2682	3237	3857	3801	77.57	3096	442.29
1	4	2	2	83	2	56	257	734	1237	1824	2543	3302	3929	3873	79.04	3195	456.43
1	4	2	2	84	2	56	275	787	1250	1795	2364	2985	3187	3131	63.90	2400	342.86
1	4	2	2	85	2	56	280	833	1363	1875	2619	3323	3830	3774	77.02	2997	428.14
1	4	2	2	87	2	56	259	832	1318	1825	2550	3254	3757	3701	75.53	2925	417.86
1	4	2	2	88	2	56	258	750	1319	1824	2468	2987	3294	3238	66.08	2544	363.43
1	4	2	2	89	2	56	223	784	1345	1893	2562	3024	3407	3351	68.39	2623	374.71
1	4	2	2	91	2	56	267	816	1354	1916	2568	3154	3908	3852	78.61	3092	441.71
1	4	2	2	92	2	56	289	833	1221	1810	2454	3019	3362	3306	67.47	2529	361.29
1	4	2	2	93	2	56	268	782	1250	1806	2520	3133	3737	3681	75.12	2955	422.14
1	4	2	2	94	2	56	256	769	1226	1928	2755	3470	4000	3944	80.49	3231	461.57
1	4	2	2	97	2	56	292	830	1285	1820	2492	3073	3761	3705	75.61	2931	418.71
1	4	2	2	99	2	56	280	792	1250	1860	2590	3260	3913	3857	78.71	3121	445.86
1	5	1	1	1	1	56	229	692	1016	1624	2108	2603	2960	2904	59.27	2268	324.00
1	5	1	1	3	1	56	227	665	1036	1605	2159	2744	3092	3036	61.96	2427	346.71
1	5	1	1	5	1	56	248	725	1236	1805	2465	3086	3550	3494	71.31	2825	403.57
1	5	1	1	6	1	56	243	659	1072	1555	2011	2392	2706	2650	54.08	2047	292.43
1	5	1	1	7	1	56	237	717	1175	1838	2434	2986	3505	3449	70.39	2788	398.29
1	5	1	1	9	1	56	205	608	1005	1409	1962	2324	2640	2584	52.73	2032	290.29
1	5	1	1	10	1	56	231	653	1026	1572	2056	2665	3189	3133	63.94	2536	362.29
1	5	1	1	11	1	56	243	650	1031	1608	2216	2786	3270	3214	65.59	2620	374.29
1	5	1	1	13	1	56	260	642	1064	1596	2057	2664	3148	3092	63.10	2506	358.00

1	5	1	1	17	1	56	235	677	1105	1628	2277	2875	3285	3229	65.90	2608	372.57
1	5	1	1	18	1	56	246	673	1138	1642	2353	2856	3415	3359	68.55	2742	391.71
1	5	1	1	19	1	56	220	630	1024	1516	2057	2502	2785	2729	55.69	2155	307.86
1	5	1	1	22	1	56	219	643	958	1496	2042	2565	2940	2884	58.86	2297	328.14
1	5	1	1	2	2	56	270	679	1105	1617	2153	2695	3286	3230	65.92	2607	372.43
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1	5	1	1	8	2	56	216	627	1038	1512	2079	2635	3234	3178	64.86	2607	372.43
1	5	1	1	12	2	56	257	683	1113	1638	2273	2868	3320	3264	66.61	2637	376.71
1	5	1	1	14	2	56	220	632	1044	1554	2235	2670	3144	3088	63.02	2512	358.86
1	5	1	1	15	2	56	229	678	1084	1632	2208	2635	3080	3024	61.71	2402	343.14
1	5	1	1	16	2	56	205	615	1084	1573	2143	2672	2918	2862	58.41	2303	329.00
1	5	1	1	20	2	56	233	646	1076	1558	2028	2486	2810	2754	56.20	2164	309.14
1	5	1	1	21	2	56	227	668	1135	1728	2227	2733	3370	3314	67.63	2702	386.00
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1	5	1	2	24	1	56	227	584	1034	1561	2387	2610	3006	2950	60.20	2422	346.00
1	5	1	2	25	1	56	253	641	1030	1560	2043	2561	2947	2891	59.00	2306	329.43
1	5	1	2	27	1	56	250	669	1129	1637	2174	2737	3213	3157	64.43	2544	363.43
1	5	1	2	28	1	56	244	611	1037	1559	2085	2522	2821	2765	56.43	2210	315.71
1	5	1	2	29	1	56	257	668	1060	1649	2264	2875	3366	3310	67.55	2698	385.43
1	5	1	2	30	1	56	242	681	1180	1785	2482	3005	3531	3475	70.92	2850	407.14
1	5	1	2	32	1	56	232	669	1068	1705	2342	2895	3602	3546	72.37	2933	419.00
1	5	1	2	33	1	56	237	645	802	1226	1850	2434	3048	2992	61.06	2403	343.29
1	5	1	2	37	1	56	261	639	1062	1627	2271	2846	3271	3215	65.61	2632	376.00
1	5	1	2	38	1	56	251	652	1138	1685	2286	2824	3015	2959	60.39	2363	337.57
1	5	1	2	39	1	56	218	682	1184	1758	2430	3073	3507	3451	70.43	2825	403.57
1	5	1	2	40	1	56	222	636	1059	1722	2178	2714	3056	3000	61.22	2420	345.71
1	5	1	2	42	1	56	222	618	1123	1753	2406	3105	3448	3392	69.22	2830	404.29
1	5	1	2	44	1	56	252	640	1075	1691	2256	2857	3232	3176	64.82	2592	370.29
1	5	1	2	46	1	56	225	643	1074	1594	2265	2702	3184	3128	63.84	2541	363.00
1	5	1	2	26	2	56	240	666	1059	1619	2222	2903	3438	3382	69.02	2772	396.00
1	5	1	2	31	2	56	210	609	1028	1650	2295	2928	3411	3355	68.47	2802	400.29
1	5	1	2	34	2	56	226	617	1065	1580	2164	2405	3369	3313	67.61	2752	393.14
1	5	1	2	35	2	56	217	603	965	1398	1935	2454	2864	2808	57.31	2261	323.00
1	5	1	2	36	2	56	234	666	1180	1850	2524	3146	3715	3659	74.67	3049	435.57
1	5	1	2	41	2	56	225	625	1036	1592	2092	2613	3249	3193	65.16	2624	374.86
1	5	1	2	43	2	56	235	655	1120	1806	2496	3082	3540	3484	71.10	2885	412.14

1	5	1	2	45	2	56	182	594	1086	1591	2386	2975	3419	3363	68.63	2825	403.57
1	5	2	1	48	1	56	289	751	1305	1824	2482	3072	3508	3452	70.45	2757	393.86
1	5	2	1	51	1	56	205	719	1238	1705	2230	2762	3150	3094	63.14	2431	347.29
1	5	2	1	55	1	56	274	692	1205	1755	2305	2827	3196	3140	64.08	2504	357.71
1	5	2	1	57	1	56	283	760	1165	1518	2073	2553	2860	2804	57.22	2100	300.00
1	5	2	1	58	1	56	266	712	1158	1543	1918	2292	2484	2428	49.55	1772	253.14
1	5	2	1	62	1	56	281	763	1102	1643	2272	2759	3090	3034	61.92	2327	332.43
1	5	2	1	63	1	56	259	762	1255	1825	2426	2955	3140	3084	62.94	2378	339.71
1	5	2	1	65	1	56	257	720	1076	1642	2157	2622	2808	2752	56.16	2088	298.29
1	5	2	1	67	1	56	302	822	1182	1665	2335	2918	3298	3242	66.16	2476	353.71
1	5	2	1	69	1	56	293	790	1262	1722	2187	2440	2698	2642	53.92	1908	272.57
1	5	2	1	70	1	56	262	712	1177	1712	2276	2863	2980	2924	59.67	2268	324.00
1	5	2	1	47	2	56	277	721	1038	1472	1935	2401	2806	2750	56.12	2085	297.86
1	5	2	1	49	2	56	245	713	1183	1725	2347	2868	3270	3214	65.59	2557	365.29
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1	5	2	1	56	2	56	282	706	1168	1671	2275	2816	3348	3292	67.18	2642	377.43
1	5	2	1	59	2	56	240	713	1203	1645	2197	2758	3068	3012	61.47	2355	336.43
1	5	2	1	60	2	56	265	717	1145	1523	2038	2315	2320	2264	46.20	1603	229.00
1	5	2	1	61	2	56	248	764	1322	1915	2593	3135	3534	3478	70.98	2770	395.71
1	5	2	1	66	2	56	230	720	1184	1643	2243	2868	3380	3324	67.84	2660	380.00
1	5	2	1	68	2	56	292	815	1305	1842	2541	3045	3435	3379	68.96	2620	374.29
1	5	2	2	72	1	56	268	738	1190	1665	2394	2756	3039	2983	60.88	2301	328.71
1	5	2	2	73	1	56	237	742	1117	1628	2287	2766	2898	2842	58.00	2156	308.00
1	5	2	2	75	1	56	279	827	1185	1609	2214	2386	2217	2161	44.10	1390	198.57
1	5	2	2	76	1	56	280	797	1116	1549	2135	2303	2558	2502	51.06	1761	251.57
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1	5	2	2	79	1	56	271	811	1210	1664	2298	2802	3084	3028	61.80	2273	324.71
1	5	2	2	81	1	56	251	741	1016	1414	1956	2284	2542	2486	50.73	1801	257.29
1	5	2	2	84	1	56	270	762	1207	1640	2145	2469	2946	2890	58.98	2184	312.00
1	5	2	2	89	1	56	278	772	965	1371	1934	2365	2524	2468	50.37	1752	250.29
1	5	2	2	91	1	56	301	835	1169	1675	2218	2662	2984	2928	59.76	2149	307.00
1	5	2	2	71	2	56	287	819	1182	1604	2114	2634	2939	2883	58.84	2120	302.86
1	5	2	2	74	2	56	278	802	1202	1785	2386	2974	3467	3411	69.61	2665	380.71

1	5	2	2	77	2	56	276	812	1220	1757	2351	2982	3471	3415	69.69	2659	379.86
1	5	2	2	80	2	56	243	790	1220	1724	2486	2975	3406	3350	68.37	2616	373.71
1	5	2	2	82	2	56	287	828	1150	1585	2186	2600	2886	2830	57.76	2058	294.00
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1	5	2	2	86	2	56	288	795	1170	1694	2395	2858	3203	3147	64.22	2408	344.00
1	5	2	2	87	2	56	312	845	1245	1780	2443	3003	3479	3423	69.86	2634	376.29
1	5	2	2	88	2	56	286	781	1150	1570	2120	2677	2948	2892	59.02	2167	309.57
1	5	2	2	90	2	56	280	789	1245	1811	2385	2947	3169	3113	63.53	2380	340.00
1	5	2	2	92	2	56	269	766	1136	1574	2052	2659	3106	3050	62.24	2340	334.29
1	5	2	2	93	2	56	282	808	1220	1665	2184	2585	2738	2682	54.73	1930	275.71
1	5	2	2	94	2	56	279	768	1175	1690	2254	2671	3064	3008	61.39	2296	328.00
1	6	1	1	1	1	56	247	679	1209	1767	2360	2810	3264	3208	65.47	2585	369.29
1	6	1	1	2	1	56	198	592	1070	1521	2035	2535	2802	2746	56.04	2210	315.71
1	6	1	1	4	1	56	191	560	935	1363	1809	2249	2524	2468	50.37	1964	280.57
1	6	1	1	5	1	56	214	623	1150	1604	2245	2806	3307	3251	66.35	2684	383.43
1	6	1	1	6	1	56	184	571	1056	1530	2186	2682	3089	3033	61.90	2518	359.71
1	6	1	1	7	1	56	245	663	1181	1670	2340	2772	3075	3019	61.61	2412	344.57
1	6	1	1	9	1	56	270	539	910	1348	1785	2185	2573	2517	51.37	2034	290.57
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1	6	1	1	14	1	56	228	607	987	1356	1905	2308	2601	2545	51.94	1994	284.86
1	6	1	1	15	1	56	264	692	1195	1772	2446	3082	3627	3571	72.88	2935	419.29
1	6	1	1	17	1	56	259	674	1136	1590	2087	2626	2991	2935	59.90	2317	331.00
1	6	1	1	18	1	56	244	697	1070	1503	2020	2502	2864	2808	57.31	2167	309.57
1	6	1	1	21	1	56	251	688	1205	1589	2203	2619	3082	3026	61.76	2394	342.00
1	6	1	1	23	1	56	205	670	1180	1704	2262	2787	3190	3134	63.96	2520	360.00
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1	6	1	1	8	2	56	273	684	1150	1673	2244	2757	3414	3358	68.53	2730	390.00
1	6	1	1	10	2	56	243	652	1036	1548	2155	2848	3440	3384	69.06	2788	398.29
1	6	1	1	12	2	56	236	694	1155	1725	2340	3064	3557	3501	71.45	2863	409.00
1	6	1	1	13	2	56	226	677	1110	1663	2168	2794	3344	3288	67.10	2667	381.00
1	6	1	1	16	2	56	205	557	985	1455	1927	2394	2827	2771	56.55	2270	324.29
1	6	1	1	19	2	56	243	673	1170	1712	2292	2993	3456	3400	69.39	2783	397.57
1	6	1	1	20	2	56	262	693	1115	1565	2026	2485	2696	2640	53.88	2003	286.14
1	6	1	1	22	2	56	222	654	1108	1636	2244	2943	3388	3332	68.00	2734	390.57
1	6	1	2	24	1	56	252	686	1160	1646	2208	2664	2933	2877	58.71	2247	321.00
1	6	1	2	28	1	56	250	656	1160	1669	2309	2855	3154	3098	63.22	2498	356.86

1	6	1	2	32	1	56	250	685	1099	1560	2134	2647	2925	2869	58.55	2240	320.00
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1	6	1	2	37	1	56	222	656	1067	1602	2248	2684	3183	3127	63.82	2527	361.00
1	6	1	2	38	1	56	239	660	1168	1692	2484	2660	3038	2982	60.86	2378	339.71
1	6	1	2	42	1	56	275	743	1200	1804	2505	3019	3186	3130	63.88	2443	349.00
1	6	1	2	43	1	56	257	678	1190	1741	2408	2960	3377	3321	67.78	2699	385.57
1	6	1	2	44	1	56	186	612	1275	1879	2584	2916	3277	3221	65.73	2665	380.71
1	6	1	2	45	1	56	245	623	1119	1635	2276	2775	3192	3136	64.00	2569	367.00
1	6	1	2	46	1	56	266	713	1235	1802	2412	2816	3153	3097	63.20	2440	348.57
1	6	1	2	47	1	56	268	722	1225	1808	2431	2898	3199	3143	64.14	2477	353.86
1	6	1	2	25	2	56	222	645	1090	1590	2250	2713	3078	3022	61.67	2433	347.57
1	6	1	2	26	2	56	225	667	1085	1592	2192	2783	3360	3304	67.43	2693	384.71
1	6	1	2	27	2	56	203	668	1130	1757	2342	2696	3276	3220	65.71	2608	372.57
1	6	1	2	29	2	56	237	692	1195	1865	2486	2954	3429	3373	68.84	2737	391.00
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1	6	1	2	31	2	56	250	695	1303	1975	2635	3097	3467	3411	69.61	2772	396.00
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1	6	1	2	35	2	56	282	720	1232	1743	2282	2796	3398	3342	68.20	2678	382.57
1	6	1	2	36	2	56	220	632	1116	1524	2005	2612	2902	2846	58.08	2270	324.29
1	6	1	2	39	2	56	239	672	1126	1646	2162	2682	2831	2775	56.63	2159	308.43
1	6	1	2	40	2	56	214	630	1080	1507	2064	2538	2963	2907	59.33	2333	333.29
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1	6	2	1	51	1	56	245	774	1292	1895	2485	2972	3253	3197	65.24	2479	354.14
1	6	2	1	52	1	56	284	817	1209	1719	2158	2454	2734	2678	54.65	1917	273.86
1	6	2	1	53	1	56	287	843	1286	1855	2373	2821	3094	3038	62.00	2251	321.57
1	6	2	1	58	1	56	289	777	1225	1657	2232	2648	2849	2793	57.00	2072	296.00
1	6	2	1	59	1	56	281	774	1240	1825	2506	3119	3453	3397	69.33	2679	382.71
1	6	2	1	63	1	56	281	757	1135	1638	2036	2478	2594	2538	51.80	1837	262.43
1	6	2	1	64	1	56	271	768	1277	1878	2392	2855	3092	3036	61.96	2324	332.00
1	6	2	1	70	1	56	308	826	1375	1962	2486	2976	3440	3384	69.06	2614	373.43
1	6	2	1	49	2	56	273	781	1222	1763	2207	2745	3096	3040	62.04	2315	330.71
1	6	2	1	50	2	56	263	761	1175	1763	2343	2742	2558	2502	51.06	1797	256.71
1	6	2	1	54	2	56	262	753	1149	1764	2204	2655	3098	3042	62.08	2345	335.00
1	6	2	1	55	2	56	276	802	1328	1865	2557	3085	3480	3424	69.88	2678	382.57
1	6	2	1	57	2	56	246	765	1095	1762	2420	2935	3313	3257	66.47	2548	364.00

1	6	2	1	58	2	56	261	785	1284	1809	2477	2949	3390	3334	68.04	2605	372.14
1	6	2	1	60	2	56	268	769	1305	1908	2602	3124	3550	3494	71.31	2781	397.29
1	6	2	1	61	2	56	280	830	1352	1862	2396	2852	3250	3194	65.18	2420	345.71
1	6	2	1	62	2	56	294	765	1165	1795	2349	2836	3270	3214	65.59	2505	357.86
1	6	2	1	65	2	56	252	748	1275	1728	2310	2754	3137	3081	62.88	2389	341.29
1	6	2	1	66	2	56	248	728	1237	1527	2114	2436	2780	2724	55.59	2052	293.14
1	6	2	1	67	2	56	255	763	1205	1695	2224	2628	3120	3064	62.53	2357	336.71
1	6	2	1	68	2	56	262	791	1268	1763	2353	2716	3060	3004	61.31	2269	324.14
1	6	2	1	69	2	56	271	784	1193	1764	2213	2565	3092	3036	61.96	2308	329.71
1	6	2	1	71	2	56	285	809	1352	1872	2353	2937	3308	3252	66.37	2499	357.00
1	6	2	1	72	2	56	261	769	1158	1735	2187	2763	3229	3173	64.76	2460	351.43
1	6	2	2	73	1	56	255	750	1305	1919	2637	3005	3373	3317	67.69	2623	374.71
1	6	2	2	74	1	56	253	745	1259	1795	2345	2854	3053	2997	61.16	2308	329.71
1	6	2	2	76	1	56	229	725	1385	2022	2104	3297	3727	3671	74.92	3002	428.86
1	6	2	2	78	1	56	252	719	1185	1752	2442	2687	3070	3014	61.51	2351	335.86
1	6	2	2	81	1	56	277	777	1372	2052	2872	3394	3777	3721	75.94	3000	428.57
1	6	2	2	82	1	56	279	739	1344	1948	2670	3097	3476	3420	69.80	2737	391.00
1	6	2	2	83	1	56	293	762	1294	1814	2587	3115	3587	3531	72.06	2825	403.57
1	6	2	2	88	1	56	279	780	1285	1942	2585	3116	3754	3698	75.47	2974	424.86
1	6	2	2	91	1	56	263	744	1235	1684	2407	2735	2927	2871	58.59	2183	311.86
1	6	2	2	92	1	56	267	752	1195	1732	2336	2787	3037	2981	60.84	2285	326.43
1	6	2	2	94	1	56	298	736	1235	1805	2419	2987	3343	3287	67.08	2607	372.43
1	6	2	2	95	1	56	266	751	1206	1754	2335	2863	3407	3351	68.39	2656	379.43
1	6	2	2	75	2	56	251	787	1381	1884	2622	2964	3364	3308	67.51	2577	368.14
1	6	2	2	77	2	56	264	728	1226	1774	2460	3003	3616	3560	72.65	2888	412.57
1	6	2	2	80	2	56	250	725	1286	1868	2466	2974	3592	3536	72.16	2867	409.57
1	6	2	2	84	2	56	292	765	1302	1893	2494	2906	3463	3407	69.53	2698	385.43
1	6	2	2	85	2	56	260	712	1252	1842	2574	3014	3486	3430	70.00	2774	396.29
1	6	2	2	86	2	56	289	762	1205	1878	2627	2995	3436	3380	68.98	2674	382.00
1	6	2	2	87	2	56	277	757	1345	1903	2581	3087	3633	3577	73.00	2876	410.86
1	6	2	2	89	2	56	276	867	1428	2062	2979	3377	4017	3961	80.84	3150	450.00
1	6	2	2	90	2	56	275	719	1126	1618	2440	2942	3555	3499	71.41	2836	405.14
1	6	2	2	93	2	56	259	751	1222	1786	2558	3176	3654	3598	73.43	2903	414.71
1	6	2	2	96	2	56	237	703	1205	1825	2544	3116	3605	3549	72.43	2902	414.57
1	6	2	2	97	2	56	225	739	1184	1862	2444	2963	3468	3412	69.63	2729	389.86

EXPERIMENT 2 : Feed consumption and conversion on DM basis																	
E	T	B	R	W1	W14	W21	W35	W49	FC7	FC14	FC21	FC28	FC35	FC42	FC49	CFC	FCR
2	1	1	1	45	571	1076	2273	3310	186	554	785	1096	1241	1604	1772	7238	2.22
2	1	1	2	45	631	1155	2345	3328	186	554	809	810	1241	1565	1707	6872	2.09
2	1	2	1	45	735	1323	2626	3588	186	554	917	1222	1426	1760	1868	7933	2.24
2	1	2	2	45	688	1237	2465	3499	186	554	876	1126	1351	1644	1751	7488	2.17
2	2	1	1	45	513	1030	2196	3237	165	499	629	1264	1556	1949	2027	8089	2.53
2	2	1	2	45	515	1029	2178	3165	165	499	646	1224	1502	1880	2075	7991	2.56
2	2	2	1	45	611	1164	2331	3454	165	499	703	1351	1742	2279	2117	8856	2.60
2	2	2	2	45	635	1175	2338	3483	165	499	695	1323	1652	2058	2108	8500	2.47
2	3	1	1	45	486	1062	2384	3571	147	503	873	1170	1343	1606	1647	7289	2.07
2	3	1	2	45	515	1070	2386	3651	147	503	832	1173	1404	1595	1786	7440	2.06
2	3	2	1	45	612	1193	2560	3894	147	503	935	1247	1381	1713	1747	7673	1.99
2	3	2	2	45	607	1241	2547	3893	147	503	1008	1241	1359	1691	1782	7731	2.01
2	4	1	1	45	525	1096	2341	3546	168	513	959	1231	1544	1804	1958	8177	2.34
2	4	1	2	45	503	991	2206	3420	168	513	864	1153	1466	1729	1954	7847	2.33
2	4	2	1	45	616	1162	2449	3651	168	513	974	1277	1466	2184	2072	8654	2.40
2	4	2	2	45	619	1158	2446	3644	168	513	966	1280	1588	1884	2095	8494	2.36
2	5	1	1	45	497	990	2144	3291	163	497	806	1128	1347	1637	1790	7368	2.27
2	5	1	2	45	506	1015	2204	3343	163	497	813	1140	1401	1548	1635	7197	2.18
2	5	2	1	45	613	1127	2414	3604	163	497	915	1268	1525	1810	1828	8006	2.25
2	5	2	2	45	617	1207	2541	3756	163	497	966	1331	1400	1788	1719	7864	2.12
2	6	1	1	45	514	1054	2313	3661	157	493	853	1156	1277	1657	1722	7315	2.02
2	6	1	2	45	458	1086	2411	3813	157	493	883	1195	1390	1770	1872	7760	2.06
2	6	2	1	45	606	1154	2444	3790	157	493	951	1187	1319	1725	1742	7574	2.02
2	6	2	2	45	624	1199	2563	3875	157	493	931	1197	1421	1707	1706	7612	1.99

EXPERIMENT 2 : Growth performance of Pekin ducks fed 6 diets including a 100% food waste diet (treatment 6)																				
E	T	B	R	#	S	W1	W14	W21	W35	W49	BWG	ADG	BWG	ADG	BWG	ADG	BWG	ADG	BWG	ADG
											1-14D	1-14D	14-21	14-21	21-35	21-35	35-49	35-49	1-49D	1-49D
2	1	1	1	1	M	45	555	1065	2198	3338	510	36.43	510	72.86	1133	80.93	1140	81.43	3293	67.20
2	1	1	1	2	F	45	542	1004	2125	3067	497	35.50	462	66.00	1121	80.07	942	67.29	3022	61.67
2	1	1	1	3	M	45	626	1109	2355	3507	581	41.50	483	69.00	1246	89.00	1152	82.29	3462	70.65
2	1	1	1	4	M	45	548	1037	2290	3625	503	35.93	489	69.86	1253	89.50	1335	95.36	3580	73.06
2	1	1	1	6	M	45	550	1092	2364	3462	505	36.07	542	77.43	1272	90.86	1098	78.43	3417	69.73
2	1	1	1	7	F	45	606	1087	2063	2896	561	40.07	481	68.71	976	69.71	833	59.50	2851	58.18
2	1	1	1	8	M	45	492	1012	2204	3376	447	31.93	520	74.29	1192	85.14	1172	83.71	3331	67.98
2	1	1	1	9	F	45	585	1035	2001	2799	540	38.57	450	64.29	966	69.00	798	57.00	2754	56.20
2	1	1	1	10	F	45	552	1030	2152	3001	507	36.21	478	68.29	1122	80.14	849	60.64	2956	60.33
2	1	1	1	11	M	45	596	1154	2235	3213	551	39.36	558	79.71	1081	77.21	978	69.86	3168	64.65
2	1	1	1	12	M	45	602	1152	2285	3349	557	39.79	550	78.57	1133	80.93	1064	76.00	3304	67.43
2	1	1	1	13	F	45	525	1091	2383	3430	480	34.29	566	80.86	1292	92.29	1047	74.79	3385	69.08
2	1	1	1	14	M	45	602	1133	2354	3338	557	39.79	531	75.86	1221	87.21	984	70.29	3293	67.20
2	1	1	1	15	M	45	584	1109	2215	3342	539	38.50	525	75.00	1106	79.00	1127	80.50	3297	67.29
2	1	1	1	16	M	45	599	1204	2514	3618	554	39.57	605	86.43	1310	93.57	1104	78.86	3573	72.92
2	1	1	1	17	F	45	532	993	2179	3085	487	34.79	461	65.86	1186	84.71	906	64.71	3040	62.04
2	1	1	1	18	M	45	623	1164	2495	3532	578	41.29	541	77.29	1331	95.07	1037	74.07	3487	71.16
2	1	1	1	19	F	45	407	885	2165	3247	362	25.86	478	68.29	1280	91.43	1082	77.29	3202	65.35
2	1	1	1	20	M	45	612	1152	2430	3698	567	40.50	540	77.14	1278	91.29	1268	90.57	3653	74.55
2	1	1	1	21	F	45	606	1138	2240	3072	561	40.07	532	76.00	1102	78.71	832	59.43	3027	61.78
2	1	1	1	22	M	45	599	1162	2450	3715	554	39.57	563	80.43	1288	92.00	1265	90.36	3670	74.90
2	1	1	1	23	F	45	628	1188	2405	3385	583	41.64	560	80.00	1217	86.93	980	70.00	3340	68.16
2	1	1	1	24	F	45	528	1002	2169	3083	483	34.50	474	67.71	1167	83.36	914	65.29	3038	62.00
2	1	1	2	25	M	45	671	1232	2488	3485	626	44.71	561	80.14	1256	89.71	997	71.21	3440	70.20
2	1	1	2	26	M	45	680	1264	2556	3463	635	45.36	584	83.43	1292	92.29	907	64.79	3418	69.76
2	1	1	2	27	M	45	685	1223	2420	3443	640	45.71	538	76.86	1197	85.50	1023	73.07	3398	69.35
2	1	1	2	28	F	45	666	1082	2397	3407	621	44.36	416	59.43	1315	93.93	1010	72.14	3362	68.61
2	1	1	2	29	M	45	685	1215	2383	3365	640	45.71	530	75.71	1168	83.43	982	70.14	3320	67.76
2	1	1	2	30	M	45	685	1246	2636	3755	640	45.71	561	80.14	1390	99.29	1119	79.93	3710	75.71
2	1	1	2	32	M	45	667	1275	2565	3601	622	44.43	608	86.86	1290	92.14	1036	74.00	3556	72.57
2	1	1	2	33	M	45	690	1392	2816	3872	645	46.07	702	100.29	1424	101.71	1056	75.43	3827	78.10
2	1	1	2	34	M	45	670	1226	2235	3354	625	44.64	556	79.43	1009	72.07	1119	79.93	3309	67.53
2	1	1	2	35	F	45	685	1186	2218	2966	640	45.71	501	71.57	1032	73.71	748	53.43	2921	59.61

EXPERIMENT 2 : Growth performance of Pekin ducks fed 6 diets including a 100% food waste diet (treatament 6)																				
E	T	B	R	#	S	W1	W14	W21	W35	W49	BWG	ADG	BWG	ADG	BWG	ADG	BWG	ADG	BWG	ADG
											1-14D	1-14D	14-21	14-21	21-35	21-35	35-49	35-49	1-49D	1-49D
2	1	1	1	1	M	45	555	1065	2198	3338	510	36.43	510	72.86	1133	80.93	1140	81.43	3293	67.20
2	1	1	1	2	F	45	542	1004	2125	3067	497	35.50	462	66.00	1121	80.07	942	67.29	3022	61.67
2	1	1	1	3	M	45	626	1109	2355	3507	581	41.50	483	69.00	1246	89.00	1152	82.29	3462	70.65
2	1	1	1	4	M	45	548	1037	2290	3625	503	35.93	489	69.86	1253	89.50	1335	95.36	3580	73.06
2	1	1	1	6	M	45	550	1092	2364	3462	505	36.07	542	77.43	1272	90.86	1098	78.43	3417	69.73
2	1	1	1	7	F	45	606	1087	2063	2896	561	40.07	481	68.71	976	69.71	833	59.50	2851	58.18
2	1	1	1	8	M	45	492	1012	2204	3376	447	31.93	520	74.29	1192	85.14	1172	83.71	3331	67.98
2	1	1	1	9	F	45	585	1035	2001	2799	540	38.57	450	64.29	966	69.00	798	57.00	2754	56.20
2	1	1	1	10	F	45	552	1030	2152	3001	507	36.21	478	68.29	1122	80.14	849	60.64	2956	60.33
2	1	1	1	11	M	45	596	1154	2235	3213	551	39.36	558	79.71	1081	77.21	978	69.86	3168	64.65
2	1	1	1	12	M	45	602	1152	2285	3349	557	39.79	550	78.57	1133	80.93	1064	76.00	3304	67.43
2	1	1	1	13	F	45	525	1091	2383	3430	480	34.29	566	80.86	1292	92.29	1047	74.79	3385	69.08
2	1	1	1	14	M	45	602	1133	2354	3338	557	39.79	531	75.86	1221	87.21	984	70.29	3293	67.20
2	1	1	1	15	M	45	584	1109	2215	3342	539	38.50	525	75.00	1106	79.00	1127	80.50	3297	67.29
2	1	1	1	16	M	45	599	1204	2514	3618	554	39.57	605	86.43	1310	93.57	1104	78.86	3573	72.92
2	1	1	1	17	F	45	532	993	2179	3085	487	34.79	461	65.86	1186	84.71	906	64.71	3040	62.04
2	1	1	1	18	M	45	623	1164	2495	3532	578	41.29	541	77.29	1331	95.07	1037	74.07	3487	71.16
2	1	1	1	19	F	45	407	885	2165	3247	362	25.86	478	68.29	1280	91.43	1082	77.29	3202	65.35
2	1	1	1	20	M	45	612	1152	2430	3698	567	40.50	540	77.14	1278	91.29	1268	90.57	3653	74.55
2	1	1	1	21	F	45	606	1138	2240	3072	561	40.07	532	76.00	1102	78.71	832	59.43	3027	61.78
2	1	1	1	22	M	45	599	1162	2450	3715	554	39.57	563	80.43	1288	92.00	1265	90.36	3670	74.90
2	1	1	1	23	F	45	628	1188	2405	3385	583	41.64	560	80.00	1217	86.93	980	70.00	3340	68.16
2	1	1	1	24	F	45	528	1002	2169	3083	483	34.50	474	67.71	1167	83.36	914	65.29	3038	62.00
2	1	1	2	25	M	45	671	1232	2488	3485	626	44.71	561	80.14	1256	89.71	997	71.21	3440	70.20
2	1	1	2	26	M	45	680	1264	2556	3463	635	45.36	584	83.43	1292	92.29	907	64.79	3418	69.76
2	1	1	2	27	M	45	685	1223	2420	3443	640	45.71	538	76.86	1197	85.50	1023	73.07	3398	69.35
2	1	1	2	28	F	45	666	1082	2397	3407	621	44.36	416	59.43	1315	93.93	1010	72.14	3362	68.61
2	1	1	2	29	M	45	685	1215	2383	3365	640	45.71	530	75.71	1168	83.43	982	70.14	3320	67.76
2	1	1	2	30	M	45	685	1246	2636	3755	640	45.71	561	80.14	1390	99.29	1119	79.93	3710	75.71
2	1	1	2	32	M	45	667	1275	2565	3601	622	44.43	608	86.86	1290	92.14	1036	74.00	3556	72.57
2	1	1	2	33	M	45	690	1392	2816	3872	645	46.07	702	100.29	1424	101.71	1056	75.43	3827	78.10
2	1	1	2	34	M	45	670	1226	2235	3354	625	44.64	556	79.43	1009	72.07	1119	79.93	3309	67.53
2	1	1	2	35	F	45	685	1186	2218	2966	640	45.71	501	71.57	1032	73.71	748	53.43	2921	59.61

2	1	1	2	36	F	45	565	1117	2332	3282	520	37.14	552	78.86	1215	86.79	950	67.86	3237	66.06
2	1	1	2	37	F	45	604	1107	2276	3288	559	39.93	503	71.86	1169	83.50	1012	72.29	3243	66.18
2	1	1	2	38	F	45	640	1162	2378	3362	595	42.50	522	74.57	1216	86.86	984	70.29	3317	67.69
2	1	1	2	39	F	45	575	1072	2221	3130	530	37.86	497	71.00	1149	82.07	909	64.93	3085	62.96
2	1	1	2	40	F	45	643	1146	2305	3158	598	42.71	503	71.86	1159	82.79	853	60.93	3113	63.53
2	1	1	2	41	F	45	582	1072	2135	2958	537	38.36	490	70.00	1063	75.93	823	58.79	2913	59.45
2	1	1	2	42	F	45	602	1139	2296	3219	557	39.79	537	76.71	1157	82.64	923	65.93	3174	64.78
2	1	1	2	43	M	45	615	1107	2235	3426	570	40.71	492	70.29	1128	80.57	1191	85.07	3381	69.00
2	1	1	2	44	F	45	613	1052	2236	3072	568	40.57	439	62.71	1184	84.57	836	59.71	3027	61.78
2	1	1	2	45	F	45	605	1117	2316	3311	560	40.00	512	73.14	1199	85.64	995	71.07	3266	66.65
2	1	1	2	46	M	45	660	1205	2283	3295	615	43.93	545	77.86	1078	77.00	1012	72.29	3250	66.33
2	1	1	2	47	F	45	672	1155	2232	3092	627	44.79	483	69.00	1077	76.93	860	61.43	3047	62.18
2	1	1	2	48	M	45	382	902	2018	3285	337	24.07	520	74.29	1116	79.71	1267	90.50	3240	66.12
2	1	1	2	49	M	45	598	1091	2296	3285	553	39.50	493	70.43	1205	86.07	989	70.64	3240	66.12
2	1	2	1	50	F	45	696	1290	2530	3167	651	46.50	594	84.86	1240	88.57	637	45.50	3122	63.71
2	1	2	1	51	M	45	738	1378	2700	3693	693	49.50	640	91.43	1322	94.43	993	70.93	3648	74.45
2	1	2	1	52	M	45	712	1329	2634	3706	667	47.64	617	88.14	1305	93.21	1072	76.57	3661	74.71
2	1	2	1	54	F	45	763	1284	2405	2954	718	51.29	521	74.43	1121	80.07	549	39.21	2909	59.37
2	1	2	1	55	M	45	718	1378	2790	4039	673	48.07	660	94.29	1412	100.86	1249	89.21	3994	81.51
2	1	2	1	56	M	45	748	1366	2760	3836	703	50.21	618	88.29	1394	99.57	1076	76.86	3791	77.37
2	1	2	1	57	M	45	830	1554	2973	4284	785	56.07	724	103.43	1419	101.36	1311	93.64	4239	86.51
2	1	2	1	58	F	45	724	1252	2445	3582	679	48.50	528	75.43	1193	85.21	1137	81.21	3537	72.18
2	1	2	1	59	M	45	712	1298	2635	3506	667	47.64	586	83.71	1337	95.50	871	62.21	3461	70.63
2	1	2	1	60	M	45	772	1407	2745	3608	727	51.93	635	90.71	1338	95.57	863	61.64	3563	72.71
2	1	2	1	61	M	45	700	1391	2690	3702	655	46.79	691	98.71	1299	92.79	1012	72.29	3657	74.63
2	1	2	1	62	F	45	705	1282	2658	3386	660	47.14	577	82.43	1376	98.29	728	52.00	3341	68.18
2	1	2	1	63	M	45	785	1464	2865	4028	740	52.86	679	97.00	1401	100.07	1163	83.07	3983	81.29
2	1	2	1	64	F	45	743	1374	2652	3536	698	49.86	631	90.14	1278	91.29	884	63.14	3491	71.24
2	1	2	1	65	F	45	784	1265	2575	3538	739	52.79	481	68.71	1310	93.57	963	68.79	3493	71.29
2	1	2	1	66	M	45	717	1233	2400	3516	672	48.00	516	73.71	1167	83.36	1116	79.71	3471	70.84
2	1	2	1	67	F	45	720	1254	2454	3250	675	48.21	534	76.29	1200	85.71	796	56.86	3205	65.41
2	1	2	1	68	F	45	701	1271	2457	3193	656	46.86	570	81.43	1186	84.71	736	52.57	3148	64.24
2	1	2	1	69	M	45	743	1325	2592	3685	698	49.86	582	83.14	1267	90.50	1093	78.07	3640	74.29
2	1	2	1	70	F	45	730	1222	2500	3337	685	48.93	492	70.29	1278	91.29	837	59.79	3292	67.18
2	1	2	1	72	F	45	705	1256	2595	3472	660	47.14	551	78.71	1339	95.64	877	62.64	3427	69.94
2	1	2	1	73	M	45	730	1362	2715	3926	685	48.93	632	90.29	1353	96.64	1211	86.50	3881	79.20

2	1	2	2	75	M	45	643	1251	2535	3750	598	42.71	608	86.86	1284	91.71	1215	86.79	3705	75.61
2	1	2	2	76	M	45	769	1351	2505	3690	724	51.71	582	83.14	1154	82.43	1185	84.64	3645	74.39
2	1	2	2	77	M	45	655	1292	2519	3990	610	43.57	637	91.00	1227	87.64	1471	105.07	3945	80.51
2	1	2	2	78	M	45	730	1307	2534	3643	685	48.93	577	82.43	1227	87.64	1109	79.21	3598	73.43
2	1	2	2	79	M	45	715	1262	2430	3320	670	47.86	547	78.14	1168	83.43	890	63.57	3275	66.84
2	1	2	2	80	M	45	668	1196	2363	3307	623	44.50	528	75.43	1167	83.36	944	67.43	3262	66.57
2	1	2	2	81	M	45	704	1252	2592	3485	659	47.07	548	78.29	1340	95.71	893	63.79	3440	70.20
2	1	2	2	82	M	45	752	1324	2663	3640	707	50.50	572	81.71	1339	95.64	977	69.79	3595	73.37
2	1	2	2	83	M	45	715	1213	2394	3430	670	47.86	498	71.14	1181	84.36	1036	74.00	3385	69.08
2	1	2	2	84	M	45	762	1274	2611	3782	717	51.21	512	73.14	1337	95.50	1171	83.64	3737	76.27
2	1	2	2	85	M	45	713	1275	2637	3570	668	47.71	562	80.29	1362	97.29	933	66.64	3525	71.94
2	1	2	2	86	F	45	643	1105	2217	2976	598	42.71	462	66.00	1112	79.43	759	54.21	2931	59.82
2	1	2	2	87	M	45	703	1252	2538	3750	658	47.00	549	78.43	1286	91.86	1212	86.57	3705	75.61
2	1	2	2	88	F	45	686	1165	2286	3274	641	45.79	479	68.43	1121	80.07	988	70.57	3229	65.90
2	1	2	2	89	F	45	640	1135	2273	3130	595	42.50	495	70.71	1138	81.29	857	61.21	3085	62.96
2	1	2	2	90	M	45	743	1310	2633	3545	698	49.86	567	81.00	1323	94.50	912	65.14	3500	71.43
2	1	2	2	91	F	45	660	1180	2464	3383	615	43.93	520	74.29	1284	91.71	919	65.64	3338	68.12
2	1	2	2	92	M	45	664	1242	2407	3629	619	44.21	578	82.57	1165	83.21	1222	87.29	3584	73.14
2	1	2	2	93	M	45	651	1233	2487	3440	606	43.29	582	83.14	1254	89.57	953	68.07	3395	69.29
2	1	2	2	94	F	45	695	1184	2457	3470	650	46.43	489	69.86	1273	90.93	1013	72.36	3425	69.90
2	1	2	2	95	M	45	683	1302	2378	3434	638	45.57	619	88.43	1076	76.86	1056	75.43	3389	69.16
2	1	2	2	96	M	45	622	1172	2265	3436	577	41.21	550	78.57	1093	78.07	1171	83.64	3391	69.20
2	1	2	2	97	F	45	665	1225	2439	3260	620	44.29	560	80.00	1214	86.71	821	58.64	3215	65.61
2	1	2	2	98	F	45	624	1180	2540	3640	579	41.36	556	79.43	1360	97.14	1100	78.57	3595	73.37
2	2	1	1	1	M	45	544	1092	2318	3390	499	35.64	548	78.29	1226	87.57	1072	76.57	3345	68.27
2	2	1	1	2	M	45	480	1082	2335	3630	435	31.07	602	86.00	1253	89.50	1295	92.50	3585	73.16
2	2	1	1	3	F	45	545	1007	2086	2890	500	35.71	462	66.00	1079	77.07	804	57.43	2845	58.06
2	2	1	1	4	M	45	548	1042	2077	2950	503	35.93	494	70.57	1035	73.93	873	62.36	2905	59.29
2	2	1	1	5	F	45	553	972	2015	2880	508	36.29	419	59.86	1043	74.50	865	61.79	2835	57.86
2	2	1	1	6	M	45	460	992	2286	4550	415	29.64	532	76.00	1294	92.43	2264	161.71	4505	91.94
2	2	1	1	7	F	45	558	1072	2164	3234	513	36.64	514	73.43	1092	78.00	1070	76.43	3189	65.08
2	2	1	1	8	F	45	433	862	1976	2926	388	27.71	429	61.29	1114	79.57	950	67.86	2881	58.80
2	2	1	1	9	F	45	485	874	1720	2250	440	31.43	389	55.57	846	60.43	530	37.86	2205	45.00
2	2	1	1	10	F	45	492	1063	2484	3210	447	31.93	571	81.57	1421	101.50	726	51.86	3165	64.59
2	2	1	1	12	M	45	565	1145	2332	3350	520	37.14	580	82.86	1187	84.79	1018	72.71	3305	67.45
2	2	1	1	13	M	45	535	1075	2260	3430	490	35.00	540	77.14	1185	84.64	1170	83.57	3385	69.08

2	2	1	1	14	F	45	550	1147	2136	2990	505	36.07	597	85.29	989	70.64	854	61.00	2945	60.10
2	2	1	1	15	F	45	495	982	2096	2878	450	32.14	487	69.57	1114	79.57	782	55.86	2833	57.82
2	2	1	1	16	F	45	544	1026	2190	3370	499	35.64	482	68.86	1164	83.14	1180	84.29	3325	67.86
2	2	1	1	17	M	45	512	1005	2158	3130	467	33.36	493	70.43	1153	82.36	972	69.43	3085	62.96
2	2	1	1	18	M	45	514	1027	2286	3320	469	33.50	513	73.29	1259	89.93	1034	73.86	3275	66.84
2	2	1	1	19	M	45	525	1056	2338	3590	480	34.29	531	75.86	1282	91.57	1252	89.43	3545	72.35
2	2	1	1	20	M	45	502	985	2206	3270	457	32.64	483	69.00	1221	87.21	1064	76.00	3225	65.82
2	2	1	1	21	M	45	525	1105	2290	3282	480	34.29	580	82.86	1185	84.64	992	70.86	3237	66.06
2	2	1	1	22	F	45	560	1108	2347	3260	515	36.79	548	78.29	1239	88.50	913	65.21	3215	65.61
2	2	1	1	24	M	45	528	1072	2213	3448	483	34.50	544	77.71	1141	81.50	1235	88.21	3403	69.45
2	2	1	2	25	F	45	530	986	2104	3010	485	34.64	456	65.14	1118	79.86	906	64.71	2965	60.51
2	2	1	2	26	M	45	505	985	2052	3005	460	32.86	480	68.57	1067	76.21	953	68.07	2960	60.41
2	2	1	2	27	M	45	404	866	2140	3682	359	25.64	462	66.00	1274	91.00	1542	110.14	3637	74.22
2	2	1	2	28	F	45	509	1032	2155	3037	464	33.14	523	74.71	1123	80.21	882	63.00	2992	61.06
2	2	1	2	29	F	45	543	984	2105	3016	498	35.57	441	63.00	1121	80.07	911	65.07	2971	60.63
2	2	1	2	30	F	45	468	984	2035	2997	423	30.21	516	73.71	1051	75.07	962	68.71	2952	60.24
2	2	1	2	31	F	45	555	1106	2340	3404	510	36.43	551	78.71	1234	88.14	1064	76.00	3359	68.55
2	2	1	2	32	F	45	508	986	2100	3115	463	33.07	478	68.29	1114	79.57	1015	72.50	3070	62.65
2	2	1	2	33	F	45	528	955	1905	2865	483	34.50	427	61.00	950	67.86	960	68.57	2820	57.55
2	2	1	2	34	M	45	515	1079	2500	3317	470	33.57	564	80.57	1421	101.50	817	58.36	3272	66.78
2	2	1	2	35	F	45	510	954	2053	2985	465	33.21	444	63.43	1099	78.50	932	66.57	2940	60.00
2	2	1	2	36	M	45	543	1108	2300	2196	498	35.57	565	80.71	1192	85.14	-104	-7.43	2151	43.90
2	2	1	2	37	M	45	560	1112	2274	3572	515	36.79	552	78.86	1162	83.00	1298	92.71	3527	71.98
2	2	1	2	38	F	45	542	1123	2369	3412	497	35.50	581	83.00	1246	89.00	1043	74.50	3367	68.71
2	2	1	2	39	M	45	582	1246	2651	3718	537	38.36	664	94.86	1405	100.36	1067	76.21	3673	74.96
2	2	1	2	40	M	45	550	1083	2435	3816	505	36.07	533	76.14	1352	96.57	1381	98.64	3771	76.96
2	2	1	2	41	M	45	564	1102	2660	4083	519	37.07	538	76.86	1558	111.29	1423	101.64	4038	82.41
2	2	1	2	42	M	45	540	1032	2120	2968	495	35.36	492	70.29	1088	77.71	848	60.57	2923	59.65
2	2	1	2	43	M	45	484	1055	2440	3916	439	31.36	571	81.57	1385	98.93	1476	105.43	3871	79.00
2	2	1	2	44	M	45	555	1107	2491	3317	510	36.43	552	78.86	1384	98.86	826	59.00	3272	66.78
2	2	1	2	45	M	45	384	816	1696	2762	339	24.21	432	61.71	880	62.86	1066	76.14	2717	55.45
2	2	1	2	46	M	45	482	963	1940	2936	437	31.21	481	68.71	977	69.79	996	71.14	2891	59.00
2	2	1	2	47	M	45	510	1105	1800	3834	465	33.21	595	85.00	695	49.64	2034	145.29	3789	77.33
2	2	1	2	48	M	45	453	856	1652	2917	408	29.14	403	57.57	796	56.86	1265	90.36	2872	58.61
2	2	2	1	50	F	45	565	1100	2061	3055	520	37.14	535	76.43	961	68.64	994	71.00	3010	61.43
2	2	2	1	51	M	45	582	1025	2230	3376	537	38.36	443	63.29	1205	86.07	1146	81.86	3331	67.98

2	2	2	1	52	M	45	564	1129	2136	3292	519	37.07	565	80.71	1007	71.93	1156	82.57	3247	66.27
2	2	2	1	53	F	45	568	1152	2193	3456	523	37.36	584	83.43	1041	74.36	1263	90.21	3411	69.61
2	2	2	1	54	M	45	632	1228	2505	3936	587	41.93	596	85.14	1277	91.21	1431	102.21	3891	79.41
2	2	2	1	55	F	45	648	1254	2482	3722	603	43.07	606	86.57	1228	87.71	1240	88.57	3677	75.04
2	2	2	1	56	F	45	601	1151	2425	3530	556	39.71	550	78.57	1274	91.00	1105	78.93	3485	71.12
2	2	2	1	57	M	45	627	1235	2503	3508	582	41.57	608	86.86	1268	90.57	1005	71.79	3463	70.67
2	2	2	1	58	M	45	584	1130	2351	3785	539	38.50	546	78.00	1221	87.21	1434	102.43	3740	76.33
2	2	2	1	59	F	45	704	1341	2643	3791	659	47.07	637	91.00	1302	93.00	1148	82.00	3746	76.45
2	2	2	1	61	M	45	620	1196	2275	3054	575	41.07	576	82.29	1079	77.07	779	55.64	3009	61.41
2	2	2	1	62	M	45	686	1270	2387	3468	641	45.79	584	83.43	1117	79.79	1081	77.21	3423	69.86
2	2	2	1	63	F	45	616	1173	2240	3037	571	40.79	557	79.57	1067	76.21	797	56.93	2992	61.06
2	2	2	1	64	M	45	583	1064	2097	3222	538	38.43	481	68.71	1033	73.79	1125	80.36	3177	64.84
2	2	2	1	65	M	45	592	1108	2165	3266	547	39.07	516	73.71	1057	75.50	1101	78.64	3221	65.73
2	2	2	1	66	F	45	570	1079	2192	3156	525	37.50	509	72.71	1113	79.50	964	68.86	3111	63.49
2	2	2	1	67	M	45	650	1202	2200	3159	605	43.21	552	78.86	998	71.29	959	68.50	3114	63.55
2	2	2	1	68	M	45	630	1306	2653	3852	585	41.79	676	96.57	1347	96.21	1199	85.64	3807	77.69
2	2	2	1	69	M	45	616	1172	2337	3437	571	40.79	556	79.43	1165	83.21	1100	78.57	3392	69.22
2	2	2	1	70	M	45	590	1160	2440	3856	545	38.93	570	81.43	1280	91.43	1416	101.14	3811	77.78
2	2	2	1	71	F	45	570	1052	2068	3266	525	37.50	482	68.86	1016	72.57	1198	85.57	3221	65.73
2	2	2	1	72	F	45	593	1164	2477	3277	548	39.14	571	81.57	1313	93.79	800	57.14	3232	65.96
2	2	2	1	73	F	45	630	1244	2563	3954	585	41.79	614	87.71	1319	94.21	1391	99.36	3909	79.78
2	2	2	2	74	M	45	671	1236	2487	3462	626	44.71	565	80.71	1251	89.36	975	69.64	3417	69.73
2	2	2	2	75	M	45	616	1022	2273	3475	571	40.79	406	58.00	1251	89.36	1202	85.86	3430	70.00
2	2	2	2	76	F	45	641	1154	2221	3383	596	42.57	513	73.29	1067	76.21	1162	83.00	3338	68.12
2	2	2	2	77	M	45	680	1272	2285	3614	635	45.36	592	84.57	1013	72.36	1329	94.93	3569	72.84
2	2	2	2	78	M	45	597	996	1997	2989	552	39.43	399	57.00	1001	71.50	992	70.86	2944	60.08
2	2	2	2	79	M	45	623	1146	2383	3529	578	41.29	523	74.71	1237	88.36	1146	81.86	3484	71.10
2	2	2	2	80	M	45	576	1155	2392	3600	531	37.93	579	82.71	1237	88.36	1208	86.29	3555	72.55
2	2	2	2	81	M	45	623	1212	2410	3533	578	41.29	589	84.14	1198	85.57	1123	80.21	3488	71.18
2	2	2	2	82	M	45	723	1337	2503	3802	678	48.43	614	87.71	1166	83.29	1299	92.79	3757	76.67
2	2	2	2	83	F	45	635	1125	2139	3295	590	42.14	490	70.00	1014	72.43	1156	82.57	3250	66.33
2	2	2	2	84	M	45	615	1149	2075	3460	570	40.71	534	76.29	926	66.14	1385	98.93	3415	69.69
2	2	2	2	85	M	45	640	1149	2293	3505	595	42.50	509	72.71	1144	81.71	1212	86.57	3460	70.61
2	2	2	2	86	M	45	635	1156	2295	3452	590	42.14	521	74.43	1139	81.36	1157	82.64	3407	69.53
2	2	2	2	87	F	45	676	1205	2361	3361	631	45.07	529	75.57	1156	82.57	1000	71.43	3316	67.67
2	2	2	2	88	M	45	612	1216	2401	3378	567	40.50	604	86.29	1185	84.64	977	69.79	3333	68.02

2	2	2	2	89	F	45	613	1115	2115	3069	568	40.57	502	71.71	1000	71.43	954	68.14	3024	61.71
2	2	2	2	90	F	45	572	1142	2346	3534	527	37.64	570	81.43	1204	86.00	1188	84.86	3489	71.20
2	2	2	2	91	F	45	620	1155	2206	3269	575	41.07	535	76.43	1051	75.07	1063	75.93	3224	65.80
2	2	2	2	92	M	45	617	1182	2615	4022	572	40.86	565	80.71	1433	102.36	1407	100.50	3977	81.16
2	2	2	2	93	M	45	676	1230	2402	3580	631	45.07	554	79.14	1172	83.71	1178	84.14	3535	72.14
2	2	2	2	94	F	45	593	1132	2351	3283	548	39.14	539	77.00	1219	87.07	932	66.57	3238	66.08
2	2	2	2	95	M	45	691	1302	2700	4023	646	46.14	611	87.29	1398	99.86	1323	94.50	3978	81.18
2	2	2	2	96	F	45	685	1205	2347	3480	640	45.71	520	74.29	1142	81.57	1133	80.93	3435	70.10
2	2	2	2	97	F	45	618	1196	2515	3503	573	40.93	578	82.57	1319	94.21	988	70.57	3458	70.57
2	3	1	1	1	F	45	520	1070	2365	3326	475	33.93	550	78.57	1295	92.50	961	68.64	3281	66.96
2	3	1	1	2	M	45	445	1015	2535	4148	400	28.57	570	81.43	1520	108.57	1613	115.21	4103	83.73
2	3	1	1	3	F	45	522	1120	2303	3297	477	34.07	598	85.43	1183	84.50	994	71.00	3252	66.37
2	3	1	1	4	F	45	430	997	2375	3495	385	27.50	567	81.00	1378	98.43	1120	80.00	3450	70.41
2	3	1	1	5	F	45	525	1184	2154	3184	480	34.29	659	94.14	970	69.29	1030	73.57	3139	64.06
2	3	1	1	6	M	45	543	1080	2366	3513	498	35.57	537	76.71	1286	91.86	1147	81.93	3468	70.78
2	3	1	1	7	M	45	439	1128	2550	3876	394	28.14	689	98.43	1422	101.57	1326	94.71	3831	78.18
2	3	1	1	8	M	45	404	965	2502	3842	359	25.64	561	80.14	1537	109.79	1340	95.71	3797	77.49
2	3	1	1	9	M	45	443	962	2290	3739	398	28.43	519	74.14	1328	94.86	1449	103.50	3694	75.39
2	3	1	1	10	F	45	450	982	2370	3527	405	28.93	532	76.00	1388	99.14	1157	82.64	3482	71.06
2	3	1	1	11	F	45	459	898	1973	2935	414	29.57	439	62.71	1075	76.79	962	68.71	2890	58.98
2	3	1	1	12	F	45	519	1063	2230	3240	474	33.86	544	77.71	1167	83.36	1010	72.14	3195	65.20
2	3	1	1	13	F	45	445	1135	2500	3752	400	28.57	690	98.57	1365	97.50	1252	89.43	3707	75.65
2	3	1	1	14	M	45	527	1177	2663	3750	482	34.43	650	92.86	1486	106.14	1087	77.64	3705	75.61
2	3	1	1	15	M	45	546	1172	2540	3653	501	35.79	626	89.43	1368	97.71	1113	79.50	3608	73.63
2	3	1	1	16	M	45	534	1154	2670	4041	489	34.93	620	88.57	1516	108.29	1371	97.93	3996	81.55
2	3	1	1	17	F	45	496	1047	2180	3157	451	32.21	551	78.71	1133	80.93	977	69.79	3112	63.51
2	3	1	1	18	M	45	515	1175	2715	4007	470	33.57	660	94.29	1540	110.00	1292	92.29	3962	80.86
2	3	1	1	19	F	45	500	1047	1884	2894	455	32.50	547	78.14	837	59.79	1010	72.14	2849	58.14
2	3	1	1	20	F	45	426	965	2280	3564	381	27.21	539	77.00	1315	93.93	1284	91.71	3519	71.82
2	3	1	1	21	M	45	465	1035	2504	3751	420	30.00	570	81.43	1469	104.93	1247	89.07	3706	75.63
2	3	1	1	22	M	45	407	950	2418	3772	362	25.86	543	77.57	1468	104.86	1354	96.71	3727	76.06
2	3	1	1	23	F	45	495	1138	2600	4036	450	32.14	643	91.86	1462	104.43	1436	102.57	3991	81.45
2	3	1	1	24	F	45	507	1026	2254	3207	462	33.00	519	74.14	1228	87.71	953	68.07	3162	64.53
2	3	1	2	25	F	45	589	935	2091	3166	544	38.86	346	49.43	1156	82.57	1075	76.79	3121	63.69
2	3	1	2	26	F	45	496	1038	2266	3394	451	32.21	542	77.43	1228	87.71	1128	80.57	3349	68.35
2	3	1	2	27	M	45	520	1105	2522	3859	475	33.93	585	83.57	1417	101.21	1337	95.50	3814	77.84

2	3	1	2	28	M	45	494	968	2237	3648	449	32.07	474	67.71	1269	90.64	1411	100.79	3603	73.53
2	3	1	2	29	M	45	512	987	2068	3315	467	33.36	475	67.86	1081	77.21	1247	89.07	3270	66.73
2	3	1	2	30	F	45	535	1085	2462	3759	490	35.00	550	78.57	1377	98.36	1297	92.64	3714	75.80
2	3	1	2	31	F	45	504	1104	2567	3724	459	32.79	600	85.71	1463	104.50	1157	82.64	3679	75.08
2	3	1	2	32	M	45	485	968	2164	3368	440	31.43	483	69.00	1196	85.43	1204	86.00	3323	67.82
2	3	1	2	33	F	45	538	1096	2377	3445	493	35.21	558	79.71	1281	91.50	1068	76.29	3400	69.39
2	3	1	2	34	M	45	554	1172	2372	3660	509	36.36	618	88.29	1200	85.71	1288	92.00	3615	73.78
2	3	1	2	35	F	45	492	1037	2517	3990	447	31.93	545	77.86	1480	105.71	1473	105.21	3945	80.51
2	3	1	2	36	M	45	533	1135	2435	3473	488	34.86	602	86.00	1300	92.86	1038	74.14	3428	69.96
2	3	1	2	37	M	45	458	987	2524	3532	413	29.50	529	75.57	1537	109.79	1008	72.00	3487	71.16
2	3	1	2	38	M	45	564	1117	2326	3736	519	37.07	553	79.00	1209	86.36	1410	100.71	3691	75.33
2	3	1	2	39	M	45	493	1112	2515	3836	448	32.00	619	88.43	1403	100.21	1321	94.36	3791	77.37
2	3	1	2	40	F	45	491	985	2244	3496	446	31.86	494	70.57	1259	89.93	1252	89.43	3451	70.43
2	3	1	2	41	F	45	522	1055	2439	3802	477	34.07	533	76.14	1384	98.86	1363	97.36	3757	76.67
2	3	1	2	42	M	45	545	1242	2604	4109	500	35.71	697	99.57	1362	97.29	1505	107.50	4064	82.94
2	3	1	2	43	M	45	473	1042	2365	3717	428	30.57	569	81.29	1323	94.50	1352	96.57	3672	74.94
2	3	1	2	44	M	45	566	1213	2651	3904	521	37.21	647	92.43	1438	102.71	1253	89.50	3859	78.76
2	3	1	2	45	F	45	528	1066	2298	3382	483	34.50	538	76.86	1232	88.00	1084	77.43	3337	68.10
2	3	1	2	46	M	45	531	1122	2592	4089	486	34.71	591	84.43	1470	105.00	1497	106.93	4044	82.53
2	3	1	2	47	F	45	540	1085	2435	3354	495	35.36	545	77.86	1350	96.43	919	65.64	3309	67.53
2	3	1	2	48	F	45	493	1016	2292	3976	448	32.00	523	74.71	1276	91.14	1684	120.29	3931	80.22
2	3	1	2	49	F	45	527	1072	2293	3546	482	34.43	545	77.86	1221	87.21	1253	89.50	3501	71.45
2	3	2	1	50	F	45	603	1142	2476	3697	558	39.86	539	77.00	1334	95.29	1221	87.21	3652	74.53
2	3	2	1	51	M	45	572	1184	2685	4317	527	37.64	612	87.43	1501	107.21	1632	116.57	4272	87.18
2	3	2	1	52	F	45	598	1230	2360	3514	553	39.50	632	90.29	1130	80.71	1154	82.43	3469	70.80
2	3	2	1	53	F	45	637	1157	2463	3641	592	42.29	520	74.29	1306	93.29	1178	84.14	3596	73.39
2	3	2	1	54	M	45	715	1463	3232	4835	670	47.86	748	106.86	1769	126.36	1603	114.50	4790	97.76
2	3	2	1	55	F	45	710	1304	2740	4038	665	47.50	594	84.86	1436	102.57	1298	92.71	3993	81.49
2	3	2	1	56	F	45	602	1138	2573	4049	557	39.79	536	76.57	1435	102.50	1476	105.43	4004	81.71
2	3	2	1	57	M	45	616	1107	2597	3854	571	40.79	491	70.14	1490	106.43	1257	89.79	3809	77.73
2	3	2	1	58	M	45	622	1245	2892	4528	577	41.21	623	89.00	1647	117.64	1636	116.86	4483	91.49
2	3	2	1	59	M	45	605	1247	2730	3855	560	40.00	642	91.71	1483	105.93	1125	80.36	3810	77.76
2	3	2	1	60	F	45	631	1155	2518	4207	586	41.86	524	74.86	1363	97.36	1689	120.64	4162	84.94
2	3	2	1	61	F	45	649	1206	2820	3873	604	43.14	557	79.57	1614	115.29	1053	75.21	3828	78.12
2	3	2	1	62	F	45	588	1138	2502	3850	543	38.79	550	78.57	1364	97.43	1348	96.29	3805	77.65
2	3	2	1	63	F	45	581	1125	2325	3285	536	38.29	544	77.71	1200	85.71	960	68.57	3240	66.12

2	3	2	1	64	M	45	615	1222	2485	3843	570	40.71	607	86.71	1263	90.21	1358	97.00	3798	77.51
2	3	2	1	65	M	45	609	1154	2340	3436	564	40.29	545	77.86	1186	84.71	1096	78.29	3391	69.20
2	3	2	1	66	M	45	614	1201	2345	3715	569	40.64	587	83.86	1144	81.71	1370	97.86	3670	74.90
2	3	2	1	67	M	45	596	1070	2140	3452	551	39.36	474	67.71	1070	76.43	1312	93.71	3407	69.53
2	3	2	1	68	M	45	609	1207	2394	3896	564	40.29	598	85.43	1187	84.79	1502	107.29	3851	78.59
2	3	2	1	69	M	45	595	1186	2590	3908	550	39.29	591	84.43	1404	100.29	1318	94.14	3863	78.84
2	3	2	1	70	M	45	576	1260	2650	3986	531	37.93	684	97.71	1390	99.29	1336	95.43	3941	80.43
2	3	2	1	71	M	45	585	1162	2467	3678	540	38.57	577	82.43	1305	93.21	1211	86.50	3633	74.14
2	3	2	1	72	M	45	576	1230	2754	4250	531	37.93	654	93.43	1524	108.86	1496	106.86	4205	85.82
2	3	2	1	73	M	45	590	1105	2365	3745	545	38.93	515	73.57	1260	90.00	1380	98.57	3700	75.51
2	3	2	2	74	F	45	564	1087	2197	4090	519	37.07	523	74.71	1110	79.29	1893	135.21	4045	82.55
2	3	2	2	75	M	45	630	1338	2857	4440	585	41.79	708	101.14	1519	108.50	1583	113.07	4395	89.69
2	3	2	2	76	M	45	636	1286	2676	3780	591	42.21	650	92.86	1390	99.29	1104	78.86	3735	76.22
2	3	2	2	77	M	45	607	1136	2286	3383	562	40.14	529	75.57	1150	82.14	1097	78.36	3338	68.12
2	3	2	2	78	M	45	729	1282	2600	4124	684	48.86	553	79.00	1318	94.14	1524	108.86	4079	83.24
2	3	2	2	79	M	45	643	1307	2655	3775	598	42.71	664	94.86	1348	96.29	1120	80.00	3730	76.12
2	3	2	2	81	M	45	605	1262	2475	3519	560	40.00	657	93.86	1213	86.64	1044	74.57	3474	70.90
2	3	2	2	82	M	45	641	1296	2194	2939	596	42.57	655	93.57	898	64.14	745	53.21	2894	59.06
2	3	2	2	83	F	45	588	1244	2636	4109	543	38.79	656	93.71	1392	99.43	1473	105.21	4064	82.94
2	3	2	2	84	F	45	560	1128	2397	4135	515	36.79	568	81.14	1269	90.64	1738	124.14	4090	83.47
2	3	2	2	85	F	45	565	1207	2392	4005	520	37.14	642	91.71	1185	84.64	1613	115.21	3960	80.82
2	3	2	2	86	F	45	682	1407	2855	3930	637	45.50	725	103.57	1448	103.43	1075	76.79	3885	79.29
2	3	2	2	87	F	45	560	1246	2642	3640	515	36.79	686	98.00	1396	99.71	998	71.29	3595	73.37
2	3	2	2	88	F	45	620	1236	2763	3869	575	41.07	616	88.00	1527	109.07	1106	79.00	3824	78.04
2	3	2	2	89	M	45	568	1179	2504	4006	523	37.36	611	87.29	1325	94.64	1502	107.29	3961	80.84
2	3	2	2	90	F	45	568	1038	2226	3365	523	37.36	470	67.14	1188	84.86	1139	81.36	3320	67.76
2	3	2	2	91	M	45	583	1272	2445	3948	538	38.43	689	98.43	1173	83.79	1503	107.36	3903	79.65
2	3	2	2	92	M	45	583	1246	2620	3907	538	38.43	663	94.71	1374	98.14	1287	91.93	3862	78.82
2	3	2	2	93	F	45	665	1442	2976	4090	620	44.29	777	111.00	1534	109.57	1114	79.57	4045	82.55
2	3	2	2	94	M	45	640	1397	2995	4505	595	42.50	757	108.14	1598	114.14	1510	107.86	4460	91.02
2	3	2	2	95	M	45	552	1166	2526	3880	507	36.21	614	87.71	1360	97.14	1354	96.71	3835	78.27
2	3	2	2	96	M	45	695	1175	2376	3525	650	46.43	480	68.57	1201	85.79	1149	82.07	3480	71.02
2	3	2	2	97	M	45	596	1282	2530	4768	551	39.36	686	98.00	1248	89.14	2238	159.86	4723	96.39
2	3	2	2	98	F	45	560	1247	2554	3690	515	36.79	687	98.14	1307	93.36	1136	81.14	3645	74.39
2	4	1	1	1	F	45	583	1214	2354	3596	538	38.43	631	90.14	1140	81.43	1242	88.71	3551	72.47
2	4	1	1	2	F	45	476	1009	2298	3370	431	30.79	533	76.14	1289	92.07	1072	76.57	3325	67.86

2	4	1	1	3	M	45	555	1215	2459	3870	510	36.43	660	94.29	1244	88.86	1411	100.79	3825	78.06
2	4	1	1	4	M	45	469	1131	2542	3618	424	30.29	662	94.57	1411	100.79	1076	76.86	3573	72.92
2	4	1	1	5	M	45	460	1010	2047	3234	415	29.64	550	78.57	1037	74.07	1187	84.79	3189	65.08
2	4	1	1	6	F	45	538	1111	2392	3743	493	35.21	573	81.86	1281	91.50	1351	96.50	3698	75.47
2	4	1	1	7	F	45	575	1162	2346	3590	530	37.86	587	83.86	1184	84.57	1244	88.86	3545	72.35
2	4	1	1	8	F	45	470	932	2329	3785	425	30.36	462	66.00	1397	99.79	1456	104.00	3740	76.33
2	4	1	1	9	F	45	570	1137	2416	3553	525	37.50	567	81.00	1279	91.36	1137	81.21	3508	71.59
2	4	1	1	10	F	45	560	1226	2505	4460	515	36.79	666	95.14	1279	91.36	1955	139.64	4415	90.10
2	4	1	1	11	F	45	486	907	2155	3330	441	31.50	421	60.14	1248	89.14	1175	83.93	3285	67.04
2	4	1	1	12	F	45	516	1096	2339	3620	471	33.64	580	82.86	1243	88.79	1281	91.50	3575	72.96
2	4	1	1	13	M	45	541	1112	2383	3450	496	35.43	571	81.57	1271	90.79	1067	76.21	3405	69.49
2	4	1	1	14	F	45	530	1137	2336	3595	485	34.64	607	86.71	1199	85.64	1259	89.93	3550	72.45
2	4	1	1	15	F	45	524	1133	2259	3240	479	34.21	609	87.00	1126	80.43	981	70.07	3195	65.20
2	4	1	1	16	F	45	530	1032	2296	3198	485	34.64	502	71.71	1264	90.29	902	64.43	3153	64.35
2	4	1	1	17	F	45	520	1052	2336	3279	475	33.93	532	76.00	1284	91.71	943	67.36	3234	66.00
2	4	1	1	18	M	45	530	1132	2265	3485	485	34.64	602	86.00	1133	80.93	1220	87.14	3440	70.20
2	4	1	1	19	F	45	501	972	2102	3050	456	32.57	471	67.29	1130	80.71	948	67.71	3005	61.33
2	4	1	1	20	F	45	519	1104	2536	3650	474	33.86	585	83.57	1432	102.29	1114	79.57	3605	73.57
2	4	1	1	21	F	45	557	1174	2305	3410	512	36.57	617	88.14	1131	80.79	1105	78.93	3365	68.67
2	4	1	1	22	M	45	540	1182	2460	4030	495	35.36	642	91.71	1278	91.29	1570	112.14	3985	81.33
2	4	1	1	23	F	45	566	1109	2326	3520	521	37.21	543	77.57	1217	86.93	1194	85.29	3475	70.92
2	4	1	1	24	M	45	536	1021	2520	3608	491	35.07	485	69.29	1499	107.07	1088	77.71	3563	72.71
2	4	1	1	25	F	45	525	1096	2207	3368	480	34.29	571	81.57	1111	79.36	1161	82.93	3323	67.82
2	4	1	2	26	M	45	493	982	2413	3790	448	32.00	489	69.86	1431	102.21	1377	98.36	3745	76.43
2	4	1	2	27	M	45	575	1131	2465	3815	530	37.86	556	79.43	1334	95.29	1350	96.43	3770	76.94
2	4	1	2	29	M	45	577	1182	2655	4303	532	38.00	605	86.43	1473	105.21	1648	117.71	4258	86.90
2	4	1	2	30	F	45	575	1064	2188	3065	530	37.86	489	69.86	1124	80.29	877	62.64	3020	61.63
2	4	1	2	31	F	45	430	909	2154	3400	385	27.50	479	68.43	1245	88.93	1246	89.00	3355	68.47
2	4	1	2	32	F	45	455	885	2096	3285	410	29.29	430	61.43	1211	86.50	1189	84.93	3240	66.12
2	4	1	2	33	M	45	525	1055	2306	3927	480	34.29	530	75.71	1251	89.36	1621	115.79	3882	79.22
2	4	1	2	34	F	45	538	996	2145	3190	493	35.21	458	65.43	1149	82.07	1045	74.64	3145	64.18
2	4	1	2	35	F	45	458	938	2054	3095	413	29.50	480	68.57	1116	79.71	1041	74.36	3050	62.24
2	4	1	2	36	F	45	403	825	1862	2632	358	25.57	422	60.29	1037	74.07	770	55.00	2587	52.80
2	4	1	2	37	F	45	526	1079	2307	3406	481	34.36	553	79.00	1228	87.71	1099	78.50	3361	68.59
2	4	1	2	38	F	45	488	957	2179	3506	443	31.64	469	67.00	1222	87.29	1327	94.79	3461	70.63
2	4	1	2	39	M	45	565	1109	2325	3630	520	37.14	544	77.71	1216	86.86	1305	93.21	3585	73.16

2	4	1	2	40	F	45	478	907	2045	2892	433	30.93	429	61.29	1138	81.29	847	60.50	2847	58.10
2	4	1	2	41	F	45	525	994	2110	3302	480	34.29	469	67.00	1116	79.71	1192	85.14	3257	66.47
2	4	1	2	42	M	45	530	1073	2326	3645	485	34.64	543	77.57	1253	89.50	1319	94.21	3600	73.47
2	4	1	2	43	F	45	488	988	2242	3655	443	31.64	500	71.43	1254	89.57	1413	100.93	3610	73.67
2	4	1	2	44	M	45	467	923	2019	3160	422	30.14	456	65.14	1096	78.29	1141	81.50	3115	63.57
2	4	1	2	45	M	45	487	918	2165	3320	442	31.57	431	61.57	1247	89.07	1155	82.50	3275	66.84
2	4	1	2	46	F	45	528	982	2162	3544	483	34.50	454	64.86	1180	84.29	1382	98.71	3499	71.41
2	4	1	2	47	F	45	413	907	2036	3248	368	26.29	494	70.57	1129	80.64	1212	86.57	3203	65.37
2	4	1	2	48	F	45	532	1006	2215	3389	487	34.79	474	67.71	1209	86.36	1174	83.86	3344	68.24
2	4	1	2	49	M	45	575	1137	2432	3775	530	37.86	562	80.29	1295	92.50	1343	95.93	3730	76.12
2	4	1	2	50	F	45	475	865	2150	3212	430	30.71	390	55.71	1285	91.79	1062	75.86	3167	64.63
2	4	2	1	51	M	45	610	1100	2340	3535	565	40.36	490	70.00	1240	88.57	1195	85.36	3490	71.22
2	4	2	1	52	M	45	588	1142	2500	3907	543	38.79	554	79.14	1358	97.00	1407	100.50	3862	78.82
2	4	2	1	53	F	45	613	1195	2565	4064	568	40.57	582	83.14	1370	97.86	1499	107.07	4019	82.02
2	4	2	1	54	F	45	604	1110	2540	3792	559	39.93	506	72.29	1430	102.14	1252	89.43	3747	76.47
2	4	2	1	55	M	45	679	1222	2490	3482	634	45.29	543	77.57	1268	90.57	992	70.86	3437	70.14
2	4	2	1	56	M	45	590	1125	2440	3561	545	38.93	535	76.43	1315	93.93	1121	80.07	3516	71.76
2	4	2	1	57	M	45	590	1112	2372	3811	545	38.93	522	74.57	1260	90.00	1439	102.79	3766	76.86
2	4	2	1	58	F	45	614	1142	2309	3325	569	40.64	528	75.43	1167	83.36	1016	72.57	3280	66.94
2	4	2	1	59	F	45	520	1263	2660	3787	475	33.93	743	106.14	1397	99.79	1127	80.50	3742	76.37
2	4	2	1	61	F	45	671	1183	2353	3252	626	44.71	512	73.14	1170	83.57	899	64.21	3207	65.45
2	4	2	1	63	F	45	612	1200	2510	3678	567	40.50	588	84.00	1310	93.57	1168	83.43	3633	74.14
2	4	2	1	64	M	45	622	1250	2598	4085	577	41.21	628	89.71	1348	96.29	1487	106.21	4040	82.45
2	4	2	1	65	F	45	670	1154	2440	3682	625	44.64	484	69.14	1286	91.86	1242	88.71	3637	74.22
2	4	2	1	66	F	45	616	1165	2365	3426	571	40.79	549	78.43	1200	85.71	1061	75.79	3381	69.00
2	4	2	1	67	F	45	616	1099	2115	3040	571	40.79	483	69.00	1016	72.57	925	66.07	2995	61.12
2	4	2	1	68	F	45	603	1092	2225	3485	558	39.86	489	69.86	1133	80.93	1260	90.00	3440	70.20
2	4	2	1	70	F	45	606	1245	2600	3760	561	40.07	639	91.29	1355	96.79	1160	82.86	3715	75.82
2	4	2	1	71	M	45	595	1114	2460	3857	550	39.29	519	74.14	1346	96.14	1397	99.79	3812	77.80
2	4	2	1	72	M	45	629	1184	2405	3642	584	41.71	555	79.29	1221	87.21	1237	88.36	3597	73.41
2	4	2	1	73	M	45	609	1215	2710	4223	564	40.29	606	86.57	1495	106.79	1513	108.07	4178	85.27
2	4	2	1	74	M	45	645	1204	2525	3739	600	42.86	559	79.86	1321	94.36	1214	86.71	3694	75.39
2	4	2	1	75	F	45	600	1072	2230	3180	555	39.64	472	67.43	1158	82.71	950	67.86	3135	63.98
2	4	2	2	76	F	45	597	1142	2451	3622	552	39.43	545	77.86	1309	93.50	1171	83.64	3577	73.00
2	4	2	2	77	F	45	580	1072	2336	3607	535	38.21	492	70.29	1264	90.29	1271	90.79	3562	72.69
2	4	2	2	78	F	45	630	1225	2760	4135	585	41.79	595	85.00	1535	109.64	1375	98.21	4090	83.47

2	4	2	2	79	F	45	580	981	1920	2993	535	38.21	401	57.29	939	67.07	1073	76.64	2948	60.16
2	4	2	2	80	F	45	604	1112	2126	3170	559	39.93	508	72.57	1014	72.43	1044	74.57	3125	63.78
2	4	2	2	81	M	45	770	1428	2827	4156	725	51.79	658	94.00	1399	99.93	1329	94.93	4111	83.90
2	4	2	2	83	M	45	638	1146	2440	3726	593	42.36	508	72.57	1294	92.43	1286	91.86	3681	75.12
2	4	2	2	84	M	45	610	1138	2572	3792	565	40.36	528	75.43	1434	102.43	1220	87.14	3747	76.47
2	4	2	2	85	M	45	640	1252	2530	3953	595	42.50	612	87.43	1278	91.29	1423	101.64	3908	79.76
2	4	2	2	86	M	45	616	1208	2533	3810	571	40.79	592	84.57	1325	94.64	1277	91.21	3765	76.84
2	4	2	2	87	F	45	601	1082	2305	3737	556	39.71	481	68.71	1223	87.36	1432	102.29	3692	75.35
2	4	2	2	88	M	45	690	1285	2754	4061	645	46.07	595	85.00	1469	104.93	1307	93.36	4016	81.96
2	4	2	2	89	F	45	594	1055	2207	3061	549	39.21	461	65.86	1152	82.29	854	61.00	3016	61.55
2	4	2	2	90	M	45	615	1135	2397	3702	570	40.71	520	74.29	1262	90.14	1305	93.21	3657	74.63
2	4	2	2	91	M	45	600	1201	2930	4194	555	39.64	601	85.86	1729	123.50	1264	90.29	4149	84.67
2	4	2	2	92	M	45	644	1207	2667	4079	599	42.79	563	80.43	1460	104.29	1412	100.86	4034	82.33
2	4	2	2	93	F	45	608	1112	2262	3266	563	40.21	504	72.00	1150	82.14	1004	71.71	3221	65.73
2	4	2	2	94	F	45	570	1151	2451	3615	525	37.50	581	83.00	1300	92.86	1164	83.14	3570	72.86
2	4	2	2	95	M	45	636	1173	2347	3597	591	42.21	537	76.71	1174	83.86	1250	89.29	3552	72.49
2	4	2	2	96	F	45	606	1086	2180	3166	561	40.07	480	68.57	1094	78.14	986	70.43	3121	63.69
2	4	2	2	97	M	45	681	1266	2617	3523	636	45.43	585	83.57	1351	96.50	906	64.71	3478	70.98
2	4	2	2	98	F	45	592	1126	2346	3501	547	39.07	534	76.29	1220	87.14	1155	82.50	3456	70.53
2	4	2	2	99	F	45	585	1086	2277	3437	540	38.57	501	71.57	1191	85.07	1160	82.86	3392	69.22
2	4	2	2	100	F	45	602	1156	2466	3509	557	39.79	554	79.14	1310	93.57	1043	74.50	3464	70.69
2	5	1	1	1	F	45	461	945	1968	2871	416	29.71	484	69.14	1023	73.07	903	64.50	2826	57.67
2	5	1	1	2	M	45	442	923	2228	3560	397	28.36	481	68.71	1305	93.21	1332	95.14	3515	71.73
2	5	1	1	3	M	45	508	1029	2230	3450	463	33.07	521	74.43	1201	85.79	1220	87.14	3405	69.49
2	5	1	1	4	M	45	546	1063	2025	3131	501	35.79	517	73.86	962	68.71	1106	79.00	3086	62.98
2	5	1	1	5	F	45	543	1105	2263	3429	498	35.57	562	80.29	1158	82.71	1166	83.29	3384	69.06
2	5	1	1	7	F	45	390	796	2010	3264	345	24.64	406	58.00	1214	86.71	1254	89.57	3219	65.69
2	5	1	1	8	M	45	529	1040	2151	3126	484	34.57	511	73.00	1111	79.36	975	69.64	3081	62.88
2	5	1	1	9	M	45	390	905	2024	3086	345	24.64	515	73.57	1119	79.93	1062	75.86	3041	62.06
2	5	1	1	10	F	45	480	974	2130	3278	435	31.07	494	70.57	1156	82.57	1148	82.00	3233	65.98
2	5	1	1	11	F	45	529	950	2000	3065	484	34.57	421	60.14	1050	75.00	1065	76.07	3020	61.63
2	5	1	1	12	M	45	561	933	2197	3647	516	36.86	372	53.14	1264	90.29	1450	103.57	3602	73.51
2	5	1	1	13	F	45	562	1109	2328	3559	517	36.93	547	78.14	1219	87.07	1231	87.93	3514	71.71
2	5	1	1	14	F	45	567	1044	2182	3372	522	37.29	477	68.14	1138	81.29	1190	85.00	3327	67.90
2	5	1	1	16	M	45	554	1056	2305	3345	509	36.36	502	71.71	1249	89.21	1040	74.29	3300	67.35
2	5	1	1	17	M	45	474	978	2000	3182	429	30.64	504	72.00	1022	73.00	1182	84.43	3137	64.02

2	5	1	1	18	M	45	488	1125	2440	3545	443	31.64	637	91.00	1315	93.93	1105	78.93	3500	71.43
2	5	1	1	19	F	45	550	1108	2167	3167	505	36.07	558	79.71	1059	75.64	1000	71.43	3122	63.71
2	5	1	1	20	F	45	534	1006	2042	3108	489	34.93	472	67.43	1036	74.00	1066	76.14	3063	62.51
2	5	1	1	21	M	45	433	966	2029	3217	388	27.71	533	76.14	1063	75.93	1188	84.86	3172	64.73
2	5	1	1	22	M	45	434	920	2100	3374	389	27.79	486	69.43	1180	84.29	1274	91.00	3329	67.94
2	5	1	1	23	M	45	540	1056	2196	3343	495	35.36	516	73.71	1140	81.43	1147	81.93	3298	67.31
2	5	1	2	24	M	45	492	1005	2134	3200	447	31.93	513	73.29	1129	80.64	1066	76.14	3155	64.39
2	5	1	2	25	F	45	451	913	1939	2920	406	29.00	462	66.00	1026	73.29	981	70.07	2875	58.67
2	5	1	2	26	F	45	517	992	2302	3397	472	33.71	475	67.86	1310	93.57	1095	78.21	3352	68.41
2	5	1	2	27	F	45	457	884	1864	2978	412	29.43	427	61.00	980	70.00	1114	79.57	2933	59.86
2	5	1	2	28	M	45	548	1125	2280	3504	503	35.93	577	82.43	1155	82.50	1224	87.43	3459	70.59
2	5	1	2	29	F	45	480	962	2017	2790	435	31.07	482	68.86	1055	75.36	773	55.21	2745	56.02
2	5	1	2	30	F	45	556	1033	2160	3162	511	36.50	477	68.14	1127	80.50	1002	71.57	3117	63.61
2	5	1	2	31	M	45	512	1066	2217	3299	467	33.36	554	79.14	1151	82.21	1082	77.29	3254	66.41
2	5	1	2	32	M	45	552	1073	2283	3376	507	36.21	521	74.43	1210	86.43	1093	78.07	3331	67.98
2	5	1	2	33	F	45	548	1064	2153	3140	503	35.93	516	73.71	1089	77.79	987	70.50	3095	63.16
2	5	1	2	34	M	45	546	1098	2453	3709	501	35.79	552	78.86	1355	96.79	1256	89.71	3664	74.78
2	5	1	2	35	M	45	564	1144	2403	3527	519	37.07	580	82.86	1259	89.93	1124	80.29	3482	71.06
2	5	1	2	36	M	45	520	1013	2286	3696	475	33.93	493	70.43	1273	90.93	1410	100.71	3651	74.51
2	5	1	2	37	M	45	557	1042	2308	3450	512	36.57	485	69.29	1266	90.43	1142	81.57	3405	69.49
2	5	1	2	38	M	45	513	1068	2400	3700	468	33.43	555	79.29	1332	95.14	1300	92.86	3655	74.59
2	5	1	2	39	M	45	340	795	2147	3346	295	21.07	455	65.00	1352	96.57	1199	85.64	3301	67.37
2	5	1	2	40	M	45	558	1194	2322	3710	513	36.64	636	90.86	1128	80.57	1388	99.14	3665	74.80
2	5	1	2	41	F	45	552	1091	2402	3454	507	36.21	539	77.00	1311	93.64	1052	75.14	3409	69.57
2	5	1	2	42	M	45	450	1022	2319	3863	405	28.93	572	81.71	1297	92.64	1544	110.29	3818	77.92
2	5	1	2	43	M	45	442	872	2000	3109	397	28.36	430	61.43	1128	80.57	1109	79.21	3064	62.53
2	5	1	2	44	F	45	523	1024	2253	3388	478	34.14	501	71.57	1229	87.79	1135	81.07	3343	68.22
2	5	1	2	45	M	45	398	901	2219	3554	353	25.21	503	71.86	1318	94.14	1335	95.36	3509	71.61
2	5	1	2	46	F	45	535	1025	1973	2996	490	35.00	490	70.00	948	67.71	1023	73.07	2951	60.22
2	5	1	2	47	F	45	538	960	2065	2970	493	35.21	422	60.29	1105	78.93	905	64.64	2925	59.69
2	5	2	1	48	F	45	615	1113	2260	3334	570	40.71	498	71.14	1147	81.93	1074	76.71	3289	67.12
2	5	2	1	49	F	45	613	1179	2365	3475	568	40.57	566	80.86	1186	84.71	1110	79.29	3430	70.00
2	5	2	1	50	M	45	598	1011	2125	3344	553	39.50	413	59.00	1114	79.57	1219	87.07	3299	67.33
2	5	2	1	51	F	45	606	1109	2302	3517	561	40.07	503	71.86	1193	85.21	1215	86.79	3472	70.86
2	5	2	1	53	M	45	573	1108	2365	3662	528	37.71	535	76.43	1257	89.79	1297	92.64	3617	73.82
2	5	2	1	54	F	45	584	1182	2536	3756	539	38.50	598	85.43	1354	96.71	1220	87.14	3711	75.73

2	5	2	1	55	M	45	614	1123	2563	4001	569	40.64	509	72.71	1440	102.86	1438	102.71	3956	80.73
2	5	2	1	56	M	45	630	1162	2402	3679	585	41.79	532	76.00	1240	88.57	1277	91.21	3634	74.16
2	5	2	1	57	M	45	644	1244	2613	3911	599	42.79	600	85.71	1369	97.79	1298	92.71	3866	78.90
2	5	2	1	58	F	45	623	1167	2378	3363	578	41.29	544	77.71	1211	86.50	985	70.36	3318	67.71
2	5	2	1	59	F	45	660	1154	2600	3852	615	43.93	494	70.57	1446	103.29	1252	89.43	3807	77.69
2	5	2	1	60	F	45	702	1205	2550	3677	657	46.93	503	71.86	1345	96.07	1127	80.50	3632	74.12
2	5	2	1	61	F	45	594	1022	2460	3525	549	39.21	428	61.14	1438	102.71	1065	76.07	3480	71.02
2	5	2	1	63	M	45	643	1115	2680	4148	598	42.71	472	67.43	1565	111.79	1468	104.86	4103	83.73
2	5	2	1	64	M	45	603	1074	2602	3719	558	39.86	471	67.29	1528	109.14	1117	79.79	3674	74.98
2	5	2	1	65	F	45	589	1142	2565	3865	544	38.86	553	79.00	1423	101.64	1300	92.86	3820	77.96
2	5	2	1	66	M	45	572	1021	2225	3264	527	37.64	449	64.14	1204	86.00	1039	74.21	3219	65.69
2	5	2	1	67	F	45	584	1108	2445	3487	539	38.50	524	74.86	1337	95.50	1042	74.43	3442	70.24
2	5	2	1	68	F	45	600	1071	2265	3468	555	39.64	471	67.29	1194	85.29	1203	85.93	3423	69.86
2	5	2	1	69	M	45	642	1175	2430	3658	597	42.64	533	76.14	1255	89.64	1228	87.71	3613	73.73
2	5	2	1	70	M	45	567	1054	2220	3368	522	37.29	487	69.57	1166	83.29	1148	82.00	3323	67.82
2	5	2	1	71	F	45	582	1131	2280	3220	537	38.36	549	78.43	1149	82.07	940	67.14	3175	64.80
2	5	2	1	72	F	45	593	1089	2405	3637	548	39.14	496	70.86	1316	94.00	1232	88.00	3592	73.31
2	5	2	2	73	F	45	631	1309	2515	3400	586	41.86	678	96.86	1206	86.14	885	63.21	3355	68.47
2	5	2	2	74	M	45	583	1292	2807	4195	538	38.43	709	101.29	1515	108.21	1388	99.14	4150	84.69
2	5	2	2	76	F	45	605	1174	2436	3624	560	40.00	569	81.29	1262	90.14	1188	84.86	3579	73.04
2	5	2	2	77	M	45	651	1233	2748	3990	606	43.29	582	83.14	1515	108.21	1242	88.71	3945	80.51
2	5	2	2	78	F	45	598	1173	2396	4390	553	39.50	575	82.14	1223	87.36	1994	142.43	4345	88.67
2	5	2	2	79	M	45	730	1336	2926	4470	685	48.93	606	86.57	1590	113.57	1544	110.29	4425	90.31
2	5	2	2	80	M	45	645	1289	2512	3569	600	42.86	644	92.00	1223	87.36	1057	75.50	3524	71.92
2	5	2	2	81	M	45	605	1247	2485	3632	560	40.00	642	91.71	1238	88.43	1147	81.93	3587	73.20
2	5	2	2	82	M	45	567	1217	2657	3950	522	37.29	650	92.86	1440	102.86	1293	92.36	3905	79.69
2	5	2	2	83	M	45	595	1202	2507	3910	550	39.29	607	86.71	1305	93.21	1403	100.21	3865	78.88
2	5	2	2	85	F	45	602	1143	2392	3268	557	39.79	541	77.29	1249	89.21	876	62.57	3223	65.78
2	5	2	2	86	F	45	601	1245	2680	3850	556	39.71	644	92.00	1435	102.50	1170	83.57	3805	77.65
2	5	2	2	87	M	45	598	1148	2420	3880	553	39.50	550	78.57	1272	90.86	1460	104.29	3835	78.27
2	5	2	2	88	M	45	583	1072	2155	3270	538	38.43	489	69.86	1083	77.36	1115	79.64	3225	65.82
2	5	2	2	89	F	45	676	1216	2570	3600	631	45.07	540	77.14	1354	96.71	1030	73.57	3555	72.55
2	5	2	2	90	F	45	659	1237	2478	3740	614	43.86	578	82.57	1241	88.64	1262	90.14	3695	75.41
2	5	2	2	91	F	45	628	1087	2289	3280	583	41.64	459	65.57	1202	85.86	991	70.79	3235	66.02
2	5	2	2	93	F	45	588	1218	2517	3540	543	38.79	630	90.00	1299	92.79	1023	73.07	3495	71.33
2	5	2	2	94	F	45	648	1352	2775	3720	603	43.07	704	100.57	1423	101.64	945	67.50	3675	75.00

2	5	2	2	95	F	45	610	1126	2283	3280	565	40.36	516	73.71	1157	82.64	997	71.21	3235	66.02
2	5	2	2	96	M	45	580	1248	2816	4325	535	38.21	668	95.43	1568	112.00	1509	107.79	4280	87.35
2	6	1	1	1	F	45	484	958	2235	3716	439	31.36	474	67.71	1277	91.21	1481	105.79	3671	74.92
2	6	1	1	2	M	45	549	1135	2740	4061	504	36.00	586	83.71	1605	114.64	1321	94.36	4016	81.96
2	6	1	1	3	F	45	569	1128	2572	4072	524	37.43	559	79.86	1444	103.14	1500	107.14	4027	82.18
2	6	1	1	5	F	45	415	883	2016	3317	370	26.43	468	66.86	1133	80.93	1301	92.93	3272	66.78
2	6	1	1	6	F	45	567	1170	2325	3642	522	37.29	603	86.14	1155	82.50	1317	94.07	3597	73.41
2	6	1	1	7	M	45	538	1026	2240	3301	493	35.21	488	69.71	1214	86.71	1061	75.79	3256	66.45
2	6	1	1	8	M	45	651	1153	2473	3856	606	43.29	502	71.71	1320	94.29	1383	98.79	3811	77.78
2	6	1	1	9	F	45	550	1092	2319	3481	505	36.07	542	77.43	1227	87.64	1162	83.00	3436	70.12
2	6	1	1	10	F	45	510	1048	2200	3369	465	33.21	538	76.86	1152	82.29	1169	83.50	3324	67.84
2	6	1	1	11	M	45	535	1153	2585	4173	490	35.00	618	88.29	1432	102.29	1588	113.43	4128	84.24
2	6	1	1	12	F	45	473	525	1930	3424	428	30.57	52	7.43	1405	100.36	1494	106.71	3379	68.96
2	6	1	1	13	M	45	530	1025	2402	3726	485	34.64	495	70.71	1377	98.36	1324	94.57	3681	75.12
2	6	1	1	14	M	45	550	1121	2359	3878	505	36.07	571	81.57	1238	88.43	1519	108.50	3833	78.22
2	6	1	1	16	M	45	520	1031	2160	3642	475	33.93	511	73.00	1129	80.64	1482	105.86	3597	73.41
2	6	1	1	17	M	45	565	1204	2702	4137	520	37.14	639	91.29	1498	107.00	1435	102.50	4092	83.51
2	6	1	1	18	F	45	572	1103	2240	3471	527	37.64	531	75.86	1137	81.21	1231	87.93	3426	69.92
2	6	1	1	20	F	45	562	1076	2470	3737	517	36.93	514	73.43	1394	99.57	1267	90.50	3692	75.35
2	6	1	1	21	F	45	529	1038	2331	3705	484	34.57	509	72.71	1293	92.36	1374	98.14	3660	74.69
2	6	1	1	22	M	45	565	1083	2507	3955	520	37.14	518	74.00	1424	101.71	1448	103.43	3910	79.80
2	6	1	1	23	F	45	461	931	2040	3245	416	29.71	470	67.14	1109	79.21	1205	86.07	3200	65.31
2	6	1	1	24	F	45	342	1178	1935	3170	297	21.21	836	119.43	757	54.07	1235	88.21	3125	63.78
2	6	1	1	25	F	45	562	1148	2430	3455	517	36.93	586	83.71	1282	91.57	1025	73.21	3410	69.59
2	6	1	2	26	M	45	435	1085	2200	4577	390	27.86	650	92.86	1115	79.64	2377	169.79	4532	92.49
2	6	1	2	27	M	45	482	978	2219	3468	437	31.21	496	70.86	1241	88.64	1249	89.21	3423	69.86
2	6	1	2	28	F	45	406	1013	2358	3521	361	25.79	607	86.71	1345	96.07	1163	83.07	3476	70.94
2	6	1	2	29	F	45	458	997	2219	3402	413	29.50	539	77.00	1222	87.29	1183	84.50	3357	68.51
2	6	1	2	30	F	45	472	1088	2360	3790	427	30.50	616	88.00	1272	90.86	1430	102.14	3745	76.43
2	6	1	2	31	F	45	513	1098	2269	3620	468	33.43	585	83.57	1171	83.64	1351	96.50	3575	72.96
2	6	1	2	32	F	45	459	971	2325	3603	414	29.57	512	73.14	1354	96.71	1278	91.29	3558	72.61
2	6	1	2	33	F	45	512	983	2187	3473	467	33.36	471	67.29	1204	86.00	1286	91.86	3428	69.96
2	6	1	2	34	M	45	536	1124	2473	3752	491	35.07	588	84.00	1349	96.36	1279	91.36	3707	75.65
2	6	1	2	35	M	45	525	1121	2491	4031	480	34.29	596	85.14	1370	97.86	1540	110.00	3986	81.35
2	6	1	2	36	F	45	448	1039	2238	3775	403	28.79	591	84.43	1199	85.64	1537	109.79	3730	76.12
2	6	1	2	38	F	45	536	1234	2702	4334	491	35.07	698	99.71	1468	104.86	1632	116.57	4289	87.53

2	6	1	2	39	M	45	525	1197	2542	4049	480	34.29	672	96.00	1345	96.07	1507	107.64	4004	81.71
2	6	1	2	40	M	45	521	1224	2629	4089	476	34.00	703	100.43	1405	100.36	1460	104.29	4044	82.53
2	6	1	2	41	M	45	528	1228	2515	3960	483	34.50	700	100.00	1287	91.93	1445	103.21	3915	79.90
2	6	1	2	42	F	45	439	1112	2763	3273	394	28.14	673	96.14	1651	117.93	510	36.43	3228	65.88
2	6	1	2	43	M	45	501	1087	2432	3807	456	32.57	586	83.71	1345	96.07	1375	98.21	3762	76.78
2	6	1	2	44	M	45	315	800	2109	3443	270	19.29	485	69.29	1309	93.50	1334	95.29	3398	69.35
2	6	1	2	45	M	45	539	1152	2512	3865	494	35.29	613	87.57	1360	97.14	1353	96.64	3820	77.96
2	6	1	2	46	M	45	503	1173	2560	4006	458	32.71	670	95.71	1387	99.07	1446	103.29	3961	80.84
2	6	1	2	47	M	45	515	1160	2496	3825	470	33.57	645	92.14	1336	95.43	1329	94.93	3780	77.14
2	6	1	2	48	M	45	513	1162	2401	3886	468	33.43	649	92.71	1239	88.50	1485	106.07	3841	78.39
2	6	1	2	49	M	45	516	1176	2463	4140	471	33.64	660	94.29	1287	91.93	1677	119.79	4095	83.57
2	6	2	1	50	F	45	590	1195	2413	3632	545	38.93	605	86.43	1218	87.00	1219	87.07	3587	73.20
2	6	2	1	51	M	45	555	1046	2235	3527	510	36.43	491	70.14	1189	84.93	1292	92.29	3482	71.06
2	6	2	1	52	F	45	592	1174	2474	3427	547	39.07	582	83.14	1300	92.86	953	68.07	3382	69.02
2	6	2	1	53	F	45	555	1076	2221	3419	510	36.43	521	74.43	1145	81.79	1198	85.57	3374	68.86
2	6	2	1	54	M	45	631	1249	2682	3928	586	41.86	618	88.29	1433	102.36	1246	89.00	3883	79.24
2	6	2	1	55	F	45	590	1066	2196	3369	545	38.93	476	68.00	1130	80.71	1173	83.79	3324	67.84
2	6	2	1	56	F	45	602	1061	2219	3669	557	39.79	459	65.57	1158	82.71	1450	103.57	3624	73.96
2	6	2	1	57	F	45	610	1208	2432	3728	565	40.36	598	85.43	1224	87.43	1296	92.57	3683	75.16
2	6	2	1	58	M	45	582	1106	2453	4019	537	38.36	524	74.86	1347	96.21	1566	111.86	3974	81.10
2	6	2	1	59	F	45	570	1194	2594	4106	525	37.50	624	89.14	1400	100.00	1512	108.00	4061	82.88
2	6	2	1	60	M	45	689	1276	2569	3693	644	46.00	587	83.86	1293	92.36	1124	80.29	3648	74.45
2	6	2	1	61	F	45	596	1104	2335	3717	551	39.36	508	72.57	1231	87.93	1382	98.71	3672	74.94
2	6	2	1	62	M	45	638	1244	2782	4347	593	42.36	606	86.57	1538	109.86	1565	111.79	4302	87.80
2	6	2	1	63	F	45	589	1010	2122	3578	544	38.86	421	60.14	1112	79.43	1456	104.00	3533	72.10
2	6	2	1	64	M	45	565	1196	2592	4176	520	37.14	631	90.14	1396	99.71	1584	113.14	4131	84.31
2	6	2	1	65	F	45	632	1263	2574	3815	587	41.93	631	90.14	1311	93.64	1241	88.64	3770	76.94
2	6	2	1	66	M	45	641	1244	2454	3655	596	42.57	603	86.14	1210	86.43	1201	85.79	3610	73.67
2	6	2	1	67	M	45	692	1462	2932	4927	647	46.21	770	110.00	1470	105.00	1995	142.50	4882	99.63
2	6	2	1	68	F	45	648	1196	2482	3629	603	43.07	548	78.29	1286	91.86	1147	81.93	3584	73.14
2	6	2	1	69	M	45	610	1179	2403	3755	565	40.36	569	81.29	1224	87.43	1352	96.57	3710	75.71
2	6	2	1	70	F	45	625	1194	2354	3596	580	41.43	569	81.29	1160	82.86	1242	88.71	3551	72.47
2	6	2	1	72	M	45	573	1162	2285	3540	528	37.71	589	84.14	1123	80.21	1255	89.64	3495	71.33
2	6	2	1	73	F	45	575	1115	2416	3914	530	37.86	540	77.14	1301	92.93	1498	107.00	3869	78.96
2	6	2	2	74	M	45	621	1252	2898	3983	576	41.14	631	90.14	1646	117.57	1085	77.50	3938	80.37
2	6	2	2	75	F	45	655	1168	2442	3594	610	43.57	513	73.29	1274	91.00	1152	82.29	3549	72.43

2	6	2	2	76	F	45	598	1175	2635	3702	553	39.50	577	82.43	1460	104.29	1067	76.21	3657	74.63
2	6	2	2	77	F	45	603	1082	2222	4282	558	39.86	479	68.43	1140	81.43	2060	147.14	4237	86.47
2	6	2	2	79	M	45	628	1262	2703	4072	583	41.64	634	90.57	1441	102.93	1369	97.79	4027	82.18
2	6	2	2	80	M	45	602	1286	2852	4313	557	39.79	684	97.71	1566	111.86	1461	104.36	4268	87.10
2	6	2	2	81	F	45	613	1177	2382	3648	568	40.57	564	80.57	1205	86.07	1266	90.43	3603	73.53
2	6	2	2	82	M	45	574	1054	2361	3648	529	37.79	480	68.57	1307	93.36	1287	91.93	3603	73.53
2	6	2	2	83	F	45	618	1044	2134	3203	573	40.93	426	60.86	1090	77.86	1069	76.36	3158	64.45
2	6	2	2	84	F	45	625	1192	2600	3726	580	41.43	567	81.00	1408	100.57	1126	80.43	3681	75.12
2	6	2	2	85	M	45	615	1272	2438	3568	570	40.71	657	93.86	1166	83.29	1130	80.71	3523	71.90
2	6	2	2	86	M	45	604	1122	2537	3779	559	39.93	518	74.00	1415	101.07	1242	88.71	3734	76.20
2	6	2	2	88	M	45	620	1202	2578	4018	575	41.07	582	83.14	1376	98.29	1440	102.86	3973	81.08
2	6	2	2	89	M	45	672	1322	2703	3996	627	44.79	650	92.86	1381	98.64	1293	92.36	3951	80.63
2	6	2	2	90	M	45	696	1252	2562	3690	651	46.50	556	79.43	1310	93.57	1128	80.57	3645	74.39
2	6	2	2	91	M	45	565	1142	2388	3615	520	37.14	577	82.43	1246	89.00	1227	87.64	3570	72.86
2	6	2	2	92	M	45	630	1298	2864	4079	585	41.79	668	95.43	1566	111.86	1215	86.79	4034	82.33
2	6	2	2	93	F	45	602	1115	2404	3623	557	39.79	513	73.29	1289	92.07	1219	87.07	3578	73.02
2	6	2	2	94	M	45	638	1272	2684	4135	593	42.36	634	90.57	1412	100.86	1451	103.64	4090	83.47
2	6	2	2	95	M	45	613	1285	2795	3980	568	40.57	672	96.00	1510	107.86	1185	84.64	3935	80.31
2	6	2	2	96	M	45	631	1212	2601	4473	586	41.86	581	83.00	1389	99.21	1872	133.71	4428	90.37
2	6	2	2	97	F	45	637	1257	2718	4160	592	42.29	620	88.57	1461	104.36	1442	103.00	4115	83.98
2	6	2	2	98	F	45	565	1142	2539	3834	520	37.14	577	82.43	1397	99.79	1295	92.50	3789	77.33

EXPERIMENT 1: CARCASS YIELD							
ID	TRT	block	rep	SEX	LBW	CAR.W	DR %
1	1	L	1	M	3.110	2.256	72.54
2	1	L	2	M	3.498	2.543	72.70
3	1	H	1	M	3.508	2.406	68.59
4	1	H	2	M	3.190	2.355	73.82
5	1	L	1	F	3.046	2.145	70.42
6	1	L	2	F	3.209	2.321	72.33
7	1	H	1	F	3.408	2.323	68.16
8	1	H	2	F	3.092	2.351	76.03
9	2	H	1	M	3.350	2.469	73.70
10	2	H	2	M	3.460	2.364	68.32
11	2	L	1	M	3.306	2.300	69.57
12	2	L	2	M	3.310	2.394	72.33
13	2	H	2	F	3.085	2.312	74.94
14	2	H	1	F	3.207	2.390	74.52
15	2	L	1	F	2.710	1.965	72.51
16	2	L	2	F	3.114	2.295	73.70
17	3	H	2	M	3.163	2.101	66.42
18	3	H	1	M	3.109	2.262	72.76
19	3	L	2	M	3.069	2.176	70.90
20	3	L	1	M	2.840	2.116	74.51
21	3	H	2	F	3.221	2.236	69.42
22	3	L	2	F	2.890	2.056	71.14
23	3	L	1	F	2.805	2.057	73.33
24	3	H	1	F	2.870	2.168	75.54
25	4	L	1	M	3.170	2.185	68.93
26	4	H	1	M	3.366	2.465	73.23
27	4	H	2	M	3.761	2.746	73.01
28	4	L	1	F	3.070	2.130	69.38
29	4	L	2	F	3.148	2.307	73.28
30	4	H	1	F	3.292	2.458	74.67
31	4	H	2	F	3.592	2.862	79.68
32	5	H	1	M	3.348	2.485	74.22
33	5	H	2	M	3.064	2.187	71.38
34	5	L	2	M	3.249	2.286	70.36
35	5	L	1	M	3.370	2.405	71.36
36	5	H	1	F	3.150	2.278	72.32
37	5	L	2	F	3.184	2.365	74.28
38	5	H	2	F	3.084	2.298	74.51
39	6	H	1	M	3.270	2.420	74.01
40	6	H	2	M	3.555	2.500	70.32
41	6	L	1	M	3.456	2.094	60.59
42	6	L	2	M	3.364	2.372	70.51
43	6	H	1	F	3.253	2.202	67.69
44	6	H	2	F	2.927	2.191	74.85
45	6	L	1	F	2.991	1.941	64.89
46	6	L	2	F	3.154	2.265	71.81

EXPERIMENT 1: CARCASS COMPOSITION									
ID	TRT	BLOCK	REP	SEX	SKIN	MEAT	BONE	FAT	SK+FAT
1	1	L	1	M	33.980	39.860	23.64	2.52	36.500
2	1	L	2	M	28.290	42.640	24.41	4.66	32.950
3	1	H	1	M	30.330	44.390	20.42	4.86	35.190
4	1	H	2	M	33.800	42.600	20.80	2.80	36.600
5	1	L	1	F	27.800	41.660	21.86	8.68	36.480
6	1	L	2	F	32.300	39.600	22.10	6.00	38.300
7	1	H	1	F	31.300	42.300	22.10	4.30	35.600
8	1	H	2	F	32.900	42.900	19.50	4.70	37.600
9	4	L	1	M	39.600	33.540	16.03	5.83	45.430
10	4	H	1	M	34.400	40.130	21.83	3.64	38.040
11	4	H	2	M	34.160	38.720	22.89	4.23	38.390
12	4	L	1	F	35.930	39.150	19.82	5.10	41.030
13	4	L	2	F	36.290	40.200	19.94	3.57	39.860
14	4	H	1	F	36.740	38.070	18.32	6.87	43.610
15	4	H	2	F	40.980	37.490	16.64	4.89	45.870
16	6	H	1	M	33.340	37.010	25.00	4.65	37.990
17	6	H	2	M	31.430	39.180	22.70	6.69	38.120
18	6	L	1	M	42.680	30.740	23.12	3.46	46.140
19	6	L	2	M	33.420	37.580	23.95	5.05	38.470
20	6	H	1	F	34.980	37.920	20.85	6.25	41.230
21	6	H	2	F	41.410	37.710	18.08	2.80	44.210
22	6	L	1	F	33.570	41.300	20.46	4.67	38.240
23	6	L	2	F	35.340	36.670	22.43	6.16	41.500

EXPERIMENT 2:CARCASS YIELD							
ID	TRT	BLOCK	REP	SEX	LBW	CAR.W	DR %
1	1	L	1	M	3.650	2.454	67.23
2	1	L	2	M	3.485	2.574	73.86
3	1	H	1	M	3.706	2.682	72.37
4	1	H	2	M	3.545	2.588	73.00
5	1	L	1	F	3.085	2.306	74.75
6	1	L	2	F	3.282	2.372	72.27
7	1	H	1	F	3.538	2.606	73.66
8	1	H	2	F	3.470	2.538	73.14
9	2	H	1	M	3.856	2.751	71.34
10	2	L	1	M	3.590	2.719	75.74
11	2	H	2	M	3.580	2.634	73.58
12	2	L	2	M	3.718	2.736	73.59
13	2	H	1	F	3.156	2.315	73.35
14	2	L	1	F	3.370	2.458	72.94
15	2	H	2	F	3.361	2.539	75.54
16	2	L	2	F	3.115	2.277	73.10
17	3	H	1	M	3.948	2.806	71.07
18	3	L	1	M	3.736	2.306	61.72
19	3	L	2	M	3.750	2.840	75.73
20	3	H	2	M	4.250	3.178	74.78
21	3	H	1	F	3.869	2.912	75.26
22	3	L	2	F	3.496	2.558	73.17
23	3	L	1	F	3.297	2.670	80.98
24	3	H	2	F	3.873	2.904	74.98
25	4	L	1	M	3.450	2.391	69.30
26	4	H	1	M	3.953	2.819	71.31
27	4	L	2	M	3.630	2.606	71.79
28	4	H	2	M	3.907	2.877	73.64
29	4	L	1	F	3.320	2.469	74.37
30	4	H	1	F	3.501	2.550	72.84
31	4	L	2	F	3.406	2.485	72.96
32	4	H	2	F	3.485	2.590	74.32
33	5	H	1	M	3.990	3.000	75.19
34	5	L	1	M	3.710	2.551	68.76
35	5	L	2	M	3.560	2.553	71.71
36	5	H	2	M	4.001	3.015	75.36
37	5	H	1	F	3.540	2.707	76.47
38	5	L	1	F	3.162	2.374	75.08
39	5	L	2	F	3.108	2.329	74.94
40	5	H	2	F	3.517	2.634	74.89
41	6	H	1	M	4.019	2.948	73.35
42	6	H	2	M	4.072	2.994	73.53
43	6	L	1	M	4.089	2.978	72.83
44	6	L	2	M	4.137	3.084	74.55
45	6	H	1	F	3.717	2.580	69.41
46	6	H	2	F	3.594	2.632	73.23
47	6	L	1	F	3.521	2.622	74.47
48	6	L	2	F	3.555	2.692	75.72

EXPERIMENT 2: CARCASS COMPOSITION									
ID	TRT	BLOCK	REP	SEX	SKIN	MEAT	BONE	FAT	SK+FAT
1	1	L	1	M	25.950	42.530	26.40	5.12	31.070
2	1	L	2	M	32.700	33.350	28.35	5.60	38.300
3	1	H	1	M	38.820	37.130	17.94	6.11	44.930
4	1	H	2	M	23.900	45.640	22.93	7.53	31.430
5	1	L	1	F	32.030	36.150	24.54	7.28	39.310
6	1	L	2	F	29.860	39.770	26.48	3.89	33.750
7	1	H	1	F	26.770	39.530	26.59	7.11	33.880
8	1	H	2	F	26.090	43.950	22.19	7.77	33.860
9	3	H	1	M	34.130	42.400	14.72	8.75	42.880
10	3	L	1	M	28.680	45.460	20.37	5.49	34.170
11	3	L	2	M	39.000	34.610	21.10	5.29	44.290
12	3	H	2	M	39.280	36.780	15.90	8.04	47.320
13	3	H	1	F	35.340	35.240	21.95	7.47	42.810
14	3	L	2	F	33.690	33.290	26.60	6.42	40.110
15	3	L	1	F	25.610	41.560	19.21	13.62	39.230
16	3	H	2	F	37.720	35.350	19.21	7.72	45.440
17	6	H	1	M	35.700	40.210	19.22	4.87	40.570
18	6	H	2	M	39.270	35.670	18.87	6.15	45.420
19	6	L	1	M	33.700	40.440	16.01	9.85	43.550
20	6	L	2	M	34.860	41.740	18.92	4.48	39.340
21	6	H	1	F	32.020	37.550	24.35	6.08	38.100
22	6	H	2	F	34.590	39.340	20.17	5.90	40.490
23	6	L	1	F	31.060	35.600	24.90	8.44	39.500
24	6	L	2	F	40.910	38.310	14.65	6.13	47.040

IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6″

APPLIED IMAGE . Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989