

**PERFORMANCE OF KENBRO CHICKEN FED COWPEA (*Vigna unguiculata*):
SOYBEAN (*Glycine max*) DIETS AT VARIOUS REPLACEMENT LEVELS**

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ABSTRACT

The demand for poultry meat has tremendously over the years, and the high cost of Soybean meal necessitates the evaluation of locally available protein ingredients which can be used as substitutes for conventional protein meals. This research sought to study the effect of substituting Soybean meal with Cowpea meal on feed intake, weight gain, feed conversion ratio and cost per kg weight gain in Kenbro chicks. The results showed that there was no significant difference in feed intake, while there was a significant difference in total weight gain (g), and feed conversion ratio. There was equally no significant difference production cost of one kg live weight and thus the study concludes that Cowpea meal can replace up to 50 % SBM (14 % of the diet) as an alternative cheaper plant protein source in Kenbro diets at 3-9 weeks of age this can be an excellent source of dietary protein.

Key Words: Kenbro, Soybean, Cowpea, Poultry Meat, Proteins

1.1 Background Information

According to Balaiel, Abdelati and Dousa (2012), the rapid increase in the world population particularly in the developing countries coupled with acute protein shortage, has necessitated the search for methods of boosting the production of foods that are cheap and rich in proteins. Livestock farming, being a major source of livelihood for most rural households, is important in the realisation of the Millennium Development Goals (MDG) number one, which aims at reducing the instances of hunger by half by the year 2015, as it impacts on the livelihoods of Kenyans (National Livestock Policy, 2008). Domestic chickens are important biological indicators of agriculture, trade and cultural contacts between societies and civilizations. According to Mwacharo, Bjornstad, Han, and Hanottee (2013), domestic chicken are present across the African continent in all agro-ecological zones ranging from settlements in the humid tropical rainforests of Central and West Africa to the highlands of East Africa and the arid and semi-arid regions the Sahel and Kalahari deserts. They further argue that with an estimated total population of 1.6 billion at the end of 2010, domestic chicken are the most common type of animal species reared in Africa, contributing significantly to the earnings from agriculture on the continent. According to Nyaga (2007), of the 25-26 % agriculture contribution to the Kenya's GDP, poultry play a major role as it accounts for 30 % of the agricultural contribution to GDP. In Kenya, more than 70% of citizens live in the rural areas. In these areas, the poultry industry had advanced over the years to become an important component of the livestock enterprises. Being the most numerous species of farm animals, domestic chicken comprise 98 % of their population and hence the most important while other types of birds including ducks, turkeys, ostriches, geese, and quails make up the remaining 2 % of the current total estimated population of about 30 million birds in Kenya (National Poultry Policy, 2008).

King`ori, Wachira, and Tuitoek (2010) concur with the above by pointing out that the poultry sub-sector creates employment and thus economically empowers a huge part of Kenya's

population. According to the Kenya National Bureau of Statistics (2010), in Kenya out of 31.8 million chickens kept, indigenous chicken account for 81 % (25.7 million) while the balance (19 %) are exotic chicken. The country produces about 20 tonnes of poultry meat worth KES 3.5 billion, an estimated 1.3 billion eggs worth KES 9.7 billion annually (Agriculture Sector Development Strategy, 2010). Over 90 % of rural households keep indigenous chickens that are key to enhanced food security, as they are kept and reared in small flocks of about 20 birds whereby producing eggs and meat, these chickens contribute to the largely deficient protein nutrition in these areas. Considering the nutritional value of poultry products, minimal labour requirements, low capital investment and relative ease of raising the indigenous chicken, they are a ideal source of food and improved income of a larger percentage of the population, especially for those affected by the HIV/AIDS pandemic (Ndegwa, Norrish, Mead, Kimani, & Wachira, 2000).

Balail *et al.* (2012) reported that animal feeds constitute more than 70 % of the management cost of a poultry enterprise protein being the most important component. Grains form the main source of energy with maize which is a preferred human food being the most significant thus creating competition that usually favours utilization by humans. Exotic poultry production relies fully on commercial feeds while indigenous birds are reared under the free-range system where they search for their feed, with little or no supplementation at all. Indigenous chicken producers are under the assumption that the birds feed well while scavenging, which is not the case and thus leads to high mortality rates and miserable performance of the chicken. The need to explore the possible methods that can be used in order to maximize poultry production while minimizing expenditure in order to reduce the price of the poultry products while maintaining similar or better nutritional value exists.

1.2 Statement of the Problem

The demand for poultry white meat has tremendously increased due to continued population growth and increased economic growth, which has subsequently raised production of chicken in the rural, urban and peri-urban areas (**Export Processing Zone Authority, 2005**). This increase in poultry production does not match with the increase in feed resources leading to high cost of the feeds, which has led to the decline in the competitiveness of Kenya's livestock industry at the international arena (NLP, 2008). According to Shi, Lu, Tong, Zou and Wang (2012), Soybean meal, as the primary and most dependable protein source for poultry feed, is becoming progressively expensive; therefore, there is a need to look for alternative economical, easily available and quality protein sources.

1.3 Objectives of the Study

- i. To determine the performance of Kenbro chicks when Soybean meal is substituted with different levels of cowpea meal.
- ii. To determine the economic viability of substituting Soybean meal with Cowpea meal in Kenbro diets.

2.1 Literature Review

2.1.1 History of Poultry Production

Domestic chicken (*Gallus gallus domesticus*) are believed to have evolved from the jungle fowl (*Gallus gallus*) and first domesticated in Southeast Asia from where they were dispersed to other parts of the world. In Africa, they are thought to have arrived through Egypt via the Middle-east between 1425 and 1123 BC. Through human migration, the chicken spread from Egypt to the South finally arriving in the Western part of Kenya at around 100 BC and Eastern Kenya around 50 AD (Magothe & Kahi, 2010).

2.1.2 Poultry Production in Kenya

According to Beyene, Ameha, Urge and Estifanos (2014), poultry farming is gaining a lot of popularity in the developing countries due to its role in availing the much-needed proteins, economic empowerment of the resource-poor sections of different societies and also its ability to fit well in the universally practiced farming systems. World meat consumption is projected to reach an average of 36.3 kg in retail weight by 2023, an increase of 2.4 kg compared with 2013. Some 72 percent of the increased consumption will come from poultry (Evans, 2014).

Current projections on poultry consumption show that there will be an increase of 2.5 % per annum up to the year 2030 globally, while other types of meat will grow at 1.7 % or less, with production in third world countries expected to grow at 3.4 % per annum up to the year 2030 (FAO, 2010). It has also been reported that in the developing world, layers can produce up to 325 eggs per annum, while broiler chicken can attain a weigh of 2.5kgs within 42 days. It is further predicted that there will be further upsurges in poultry production in developing countries in the next two decades where demand for animal proteins will continue to be triggered by enhanced economic growth, industrialization and increased disposable income among the populace. Among the many of factors that have contributed to the increase in poultry production worldwide include, i) genetic progress in the various strains of poultry ii) enhanced knowledge on nutritional requirements, and iii) improved control of diseases.

This continued growth in poultry production translates to an increased requirement for raw materials and animal feed. It is therefore important that reasonably priced high-quality feeds are easily available in order to make poultry production competitive. Between 65-80 % of the population in Kenya and elsewhere in the sub-Saharan Africa live in rural areas where subsistence farming is the main source of livelihood which is often practiced under very difficult climatic and economic conditions. Proper harnessing and utilization of local resources could lead

to improvement in the agricultural output in rural areas. Over the years, the poultry sector has witnessed a considerable transformation in a number of phases including i) the traditional systems, including traditional chicken rearing; ii) small-scale and quasi-commercial rearing and iii) full commercial rearing. Each of these phases is characterized by a unique set of technologies which differ significantly in terms of initial investment, type of chicken, husbandry level and inputs (FAO, 2014). Family poultry significantly contributes positively to the rural family economic status especially for the landless and women who are very active in poultry husbandry (Nchida, Thieme, Ankers, Crespi & Ariste, 2011). As far as diversifying agricultural production and increasing household food security is concerned, rural poultry is an important element. The village chickens are much appreciated for providing readily harvestable animal protein to rural households, and in some parts of Africa are raised to meet the obligation of entertaining honoured guests (FAO, 1998). According to King`ori, *et al.* (2010) sale of poultry products can help to increase and diversify revenue in the livestock sector as by keeping only 3 mature hens, a household can rise above poverty level and it can also be nutritionally secure within one year. Poultry sub-sector, therefore, creates employment and promotes overall economic development.

2.2 Chicken Breeds

According to the Ministry of Livestock Development [MLD] (2008), there are more than 300 breeds of the domestic chicken species (*Gallus domesticus*) all over the world. Three main categories of chicken breeds exist; indigenous breeds, pure commercial breeds and hybrid breeds resulting from cross-breeding.

2.2.1 Indigenous Chicken

Indigenous chickens make up a large proportion of the many local resources found in rural areas that, which if well managed, could help to ease the burden of the people living in these areas (Ndegwa *et al.*, 2000). They are more numerous than the exotic chicken in Kenya (Ministry of

Agriculture Livestock Development and Marketing [MALDM], 2000). Nearly 98 % of families in rural Kenya keep small flocks of indigenous chickens (Brownhill, Bukania, Bothi, Mungube, Muhammad & Njuguna, 2014), and it is estimated that in Kenya, over 75 % of the 47 counties have identified indigenous chicken as one of their priority agricultural product value chain and produce about 55 and 47 % of the total meat and eggs respectively (Kenya Rural Development Programme, 2014). According to Eekeren, Maas, Saatkamp & Verschuur (2006), indigenous chicken has smaller and fewer eggs and weigh less when compared to the hybrid breeds.

2.2.2 Meat Birds

Broiler chicken

In poultry farms focused on meat production, broiler breeders are raised mainly in environmentally controlled poultry houses. Fertile eggs are collected and transported to the hatchery, where they are placed in hatcheries for 18 days and then transferred to incubators in the last 3 days (Beutler, 2007). After hatching, broiler chicks are distributed to producers who grow out the birds and send them for slaughtering and processing after 42 days. Broilers generally have a larger body frame and weight more than layers (Beutler, 2007).

Kenbro Chicken

The Small Business Kenya (2012) and The Organic Farmer (2015) reports that the Kenbro breed was developed and introduced to the Kenyan poultry keepers a decade ago by Kenchic Ltd. Specifically, it was developed to address the high demand for chickens in the western region of Kenya and is a dual-purpose breed which is hardier and does well under the local conditions requiring less intensive management as compared to hybrid chicken. The breed is more resistant to diseases and does well in free range. With proper feeding, the bird matures at a quick rate and can weigh up to 4 kilograms and begins to lay eggs in about 5 months. Other meat birds produced in Kenya include the Kuroiler chicken, which is a multi-purpose breed that was

introduced in Uganda in the year 2009 from Keggs Farm, India. Similar to the Kuroiler breed, the Rainbow Rooster multi-purpose breed that can be bred both eggs and meat. It is generally a low maintenance breed that is well adapted to free range. Due to the fact that it feeds heavily, it gains weight faster, with an average bird weighing about 3-4 kilograms in a span of 6 months.

2.3 Poultry Nutrition

2.3.1 Quality of Poultry Feeds in Kenya

Animal performance is largely dependent on the quality of nutrition which is usually the most critical factor especially in determining productivity for both ruminants and non-ruminants (Carson, Warghorn, Ulyatt & Lee, 1999). Despite the animal feed industry playing the noble role of providing high-quality livestock feeds which are able to meet the nutrient requirements of livestock in different stages of growth, animal feeds currently found in the market are of poor quality, which has led to an outcry from livestock farmers. The quality of animal feeds is crucial to improving the productivity of livestock, and thus the composition and formula of the feeds must be assessed to gauge if it contains harmful substances such as aflatoxins or drug-resistant bacteria. Feed quality is key in determining livestock productivity and is mostly assessed in terms of nutrient composition as well as the presence or absence of substances that may be harmful to human and animal health e.g. aflatoxins or multi-drug resistant bacteria.

Some factors such as lack of uniform standards cost and availability of raw materials have contributed to the poor quality of available feeds, with the supply equally affected due to pricing, processing and storage methods (NLP, 2008). Despite the existence of basic standards as outlined by the Kenya Bureau of Standards (KEBS), a majority of manufacturers in Kenya produce substandard animal feeds, with a small number of manufacturers maintaining acceptable standards in their animal feed formulations. Substandard animal feeds affect the growth of chickens, leading to reduced production of eggs and making them prone to diseases or even

death. Thus one of the best methods that farmers can reduce costs associated with animal feeds while maintaining quality is by formulating poultry feeds on the farm by using available inputs such as soya beans, fish meal (Omena) whole maize and maize germ combined with additional feed additives (micronutrients, minerals and vitamins) to enhance the nutritional value of the feed. Farmers who prepare their own animal feeds make a saving of about 30 to 50 percent for every 70 kg bag of animal feed, which translates to the realization of improved savings on the cost of animal feeds, which contribute about 80% of the cost of production (The Organic Farmer, 2015).

2.3.2 Feed Resources for Meat Chicken and Free Range Poultry

Since feed is a major component of the total cost of meat chicken production, their rations should be well formulated so as to supply the correct requirements for energy, protein and amino acids, minerals, vitamins and essential fatty acids in order to enable optimum growth and performance (Arbor, 2009). Nutritive value of a specific feed or diet is reflected in terms of feed intake and the efficiency of extraction of nutrients from the feed during digestion. The intake of nutrients by meat chickens is determined by the amount of feed eaten and the nutrient levels in the diet. Therefore, for a successful meat bird production program birds need to be supplied with poultry feed of the highest possible quality, in terms of ingredients used, processing methods used as well as the form in which the diet is offered (Hafeni, 2013). On the other hand, chicken kept under the free-range poultry rearing system receive minerals and vitamins adequately due to the abundance of worms, insects and other green materials, especially during the rainy seasons. Goncalves (2005) has further stated that additional sources of feed include household waste, environmental materials, wild fodder, and cultivated materials. Other materials include grain products from farming and processing and also various seeds and greens. Most of these materials mentioned are high in fiber but are energy deficient. Overall, the animal feed given to poultry

lacks all major nutrients namely such as proteins energy, calcium and phosphorus. This scavenging feed resource base nutritionally fluctuates seasonally as well as between different villages and farmsteads. Thus it is clear that chickens cannot rely on scavenging alone if optimum growth and performance are to be expected from them. By deliberately administering small amounts of supplements to the poultry, production increases while minimizing mortality rates (Ravindran, 2010).

2.4 Utilisation of Tropical Legumes as Protein Source in Meat Birds

According to **Banaszkiewicz (2011)**, there exists a possibility of replacing imported soybean meal by sourcing for proteins from domestic sources. Tropical legume grains represent a potentially important source of protein and energy for farm animals with the increasing demand for protein sources in the tropics coupled with the relatively high cost of imported raw materials attention has turned to the exploitation of alternative grain legume.

2.4.1 Soybean Meal

The above authors further reported that Soybean meal (SBM) is often the major source of dietary protein in meat chicken diets due its favorable 44-48 % crude protein composition. Soybean meal is an animal feed supplement that is rich in energy content and an ideal amino acid profile. Globally, the United States dominates soybean production followed by Brazil and Argentina. According to Jacob (2015), poultry can be fed Soybeans whole or as Soybean meal which is a by-product of oil extraction. Soybean meal is extracted oil of the Soybean seeds and is widely used in commercial production systems. Pressure is applied to the soybeans in order to extract the oil using methods such as mechanical extraction, or by solvent extraction, even though mechanically extracted soybean meal is used in organic poultry diets. In comparison to other plant protein sources, soybean meal has significantly higher protein content. This outstanding amino acid profile of Soybean complements very well that of maize, which is the de-

facto source of energy in the diet of poultry. Chakam, Tegua, and Ychoumboue (2010) predict that due to the unending increase of the price of Soybean in poultry diets on the international market, there is the real possibility of the staple protein source for poultry will become unaffordable in the future, low-income African countries south of the Sahara being affected the most.

2.5.2 Cowpea Meal

Cowpea is grown in around 45 countries across the world with an estimated worldwide acreage of 14.5 million under cowpeas per annum, about 84% of this acreage found in Sub-Saharan Africa with production projected to grow at the rate of 2.6 % per annum. Globally the average production of cowpea is estimated at about 450 kg per ha while in Kenya most varieties range from 800-1800 Kg/ha or 320-720 kg/acre (Abate, Alene, Bergvinson, Silim, Orr & Asfaw, 2011). Recent works have revealed that cowpea has encouraging potential as feeding stuff for poultry. Its incorporation in diets of these species has helped to reduce the cost/kg of feed and improved growth and production parameters (Kana, Tegua & Fomekong, 2012). Nell & Siebrits (1992) did a study and found cowpea meal to be a valuable protein source which can help in addressing the predicted protein shortage by supplying this important nutrient to the animal feed industry. The cowpea post-harvest handling and preservation poses a major challenge in developing countries. This is due to the fact that it is prone to attack by post-harvest pests which can easily destroy huge amounts of cowpeas in a matter of months. Thus farmers in Semi-arid areas of Africa are forced to sell much of their cowpea produce soon after harvest in order to forestall losses due to damage by storage pests which often lead to loss of income as prices are normally low around this time (FAO, 2004). The susceptibility of cowpeas to post-harvest pests has remained the most significant challenge to its production by many farmers (Department Of Agriculture, Forestry and Fisheries, 2011).

2.6 Nutrient Content of Cowpea and Soybean Meals

Cowpea seed is a nutritious component in the human diet, as well as a nutritious livestock feed. Cowpea seeds together with the hull contain 24.8 % Crude protein, 0.91 % ether extract, 3.46 % Crude fibre and 3.33 % ash on dry matter basis. Generally the grain contains 200-300 g protein and about 600 g of carbohydrates kg^{-1} seed (Tshovhoye *et al.*, 2003). Much of the protein is contained in the cotyledons as they are said to contain 90 % of the protein and mineral of the whole seed, while the seed accounts for 32 to 50 % of the calcium of the whole seed. Cowpea seeds contain high level of Methionine and Lysine than other legume seeds and thus they can be used to replace protein sources with admirable results till the level of 20 %. Broiler chicks have been found to tolerate cowpea inclusion levels of 20 % in their diets leading to a positive effect on body gain and performance (Musa, Elamin, Abdelati, Elagib & Musa, 2012). The protein in cowpea seed is high in the amino acids, lysine and tryptophan, compared to cereal grains; however, it is low in methionine and cystine when compared to animal proteins. According to Frimpong (2013), Soybean meal is an important source of protein that is used in poultry feeds. De-hulled Soybean meal usually contains 48 % protein as compared to when it has most of soybean hull because in this state it contains 44 % protein. With regard to this high protein content, the soybean meal is mainly used in poultry and pigs nutrition.

3.1 Research Design

3.1.1 Location of the study

The study was conducted for 42 days in Kiatineni Farm in Kinyaatta Location, Yatta Sub County. The farm is 20 km to the east of Kithimani Town (Sub County Headquarters).

3.1.2 Climatology

Yatta Sub County experiences harsh climatic conditions characterized by unreliable low rainfall in the range of 450-800mm per year with temperatures ranging between 20⁰-30 ⁰C. It is in Ecozone 4 and 5, agriculturally classified under LM4 and LM5.

3.2 Experimental Procedure

3.2.1 Preparation of The Experimental Meals

Cowpea meal-Cowpea (CWP) seeds obtained from Matuu market were used. The seeds were sorted and screened to remove the bad ones and ones and milled to allow passage through a 3 mm sieve in a hammer mill before being included in the diets.

Maize meal-All the maize used was obtained from the farm and was sorted to remove the bad ones and milled to allow passage through a 3 mm sieve in a hammer mill before being included in the diets.

Soya bean meal - Was bought from an animal feeds dealer based in Nairobi which for uniformity was also milled to pass through a 3 mm sieve in a hammer mill.

Amino acids, molasses and other additives-were bought from various agro-dealers based in Nairobi and Matuu town. Determination of the nutritional values of the feed ingredients samples of Cowpea meal, Soybean meal and maize meal were prepared and send to the Kenya Dairy Research Institute of the Kenya Agriculture and Livestock Research Organisation (KALRO) laboratory in Naivasha where dry matter (DM), crude protein (CP), ash, fat (EE), calcium, phosphorus and crude fibre (CF) was determined.

Preparation of the experimental diets- Using computer software a basal diet based on the maize and Soybean meal was formulated using maize meal, Soybean meal (SBM), Amino acids, molasses and vitamin-mineral premix. Four other diets were also developed by substituting the soybean meal with the cowpea meal at 25 %, 50 %, 75 % & 100 %.

3.2.2 The Chicks and Their Management

A total of 120 three weeks old unsexed Kenbro chicks were used in this experiment. They were obtained from Kenchic Ltd in Athi River Town as day olds and brooded using a charcoal burner for a total of 3 weeks. During this period they were fed on chick mash until they were 21 days old. At day 22 these chicks were randomly distributed over 15 cages (experimental units) in a completely randomised design comprising the 5 treatments with 24 chicks per treatment, each treatment had 3 replicates with 8 birds per replicate. The birds were fed in groups of 8 whereby one feeder and a drinker were provided and hanged in each cage. The height of the feeders was adjusted to the shoulder level of the birds to reduce feed wastage.

Feed and water were offered ad libitum for 42 days (from 8.30 to 6.30 pm) and records of feed intake were used to compute average weekly feed consumption per bird.

Housing and cages - Fifteen cages measuring 1.2 m by 1 m were constructed in a clean well-ventilated and disinfected poultry house (6x4 m²) with a concrete floor and walls made of corrugated iron sheets. The cages were placed in 3 rows each row with 5 cages placed next to each other. The front and top side of the cages were covered with chicken wire while the lateral sides were covered with pieces of plywood which also formed the partition between one cage and the other. Each cage was with a single feeder and drinker.

3.2.3 Disease Control

Before receiving the chicks the house was cleaned and disinfected. The chicks were vaccinated against Newcastle, Gumboro, Fowlpox and Fowl typhoid diseases.

3.3 Treatment and Treatment Combinations

Five experimental diets were prepared each to provide the recommended mineral and vitamin amounts for the 3-6 weeks old Kenbro chicks. The diets were developed by substituting the

Soybean meal with the cowpeas meal at 0 %, 25 %,50 %,75 % & 100 % levels .The experimental diets prepared and used were as follows;

(i) Treatments

Soya bean meal levels – 100 %, 75 %, 50 %, 25 % & 0 %

Cowpea meal levels- 0 %, 25 %, 50 %, 75 % & 100 %

D1 D2 D3 D4 D5

(ii) Treatment combinations

The composition of experimental diets from the above treatments was as follows;

Table 3.1: Composition of experimental diets

	D1 %	D2	D3	D4	D5
Maize grain	62.5	62.5	62.5	62.5	62.5
Soybean meal	28	21	14	7	0
Cowpea meal	0	7	14	21	28
Vegetable oil	2	2	2	2	2
NaCl	0.2	0.2	0.2	0.2	0.2
DCP	3.5	3.5	3.5	3.5	3.5
Methionine	0.2	0.2	0.2	0.2	0.2
Lysine	0.3	0.3	0.3	0.3	0.3
Broiler finisher premix	0.3	0.3	0.3	0.3	0.3
Molasses	3	3	3	3	3
Total	100	100	100	100	100

Table 3.2: Nutrient composition of the experimental diets

Sample Number	Dry Matter (%)	Protein (%)	Energy Kcal	Crude Fibre (%)	Crude Fat (%)	Starch (%)	Sugar (%)	Lysine (ppm)	Tryptophan (ppm)	Methionine (ppm)
D3	87.82	17.63	2927.17	5.15	5.48	41.02	2.89	2.93	1.79	6.15
D4	87.48	16.00	2989.05	4.55	5.32	44.87	2.18	0.32	1.42	4.41
D5	87.05	13.70	2983.60	4.93	5.50	46.37	1.91	0.16	1.46	5.64
D1	88.07	20.67	2959.48	4.81	5.36	38.70	4.06	6.56	2.38	6.53
D2	87.93	19.12	2910.35	4.65	5.54	39.98	3.66	4.28	1.98	5.64

3.4 Data Collection

Data collected was as follows;

3.4.1 Nutrient Content of the Feed Ingredients

Samples of test ingredients ;maize meal, soya bean meal and cowpea meal were packaged and sent to the Kenya Dairy Research Institute of the Kenya Agriculture and Livestock Research Organisation (KALRO) laboratory in Naivasha where dry matter (DM), crude protein (CP), ash, fat (EE), calcium, phosphorus and crude fibre (CF) were determined. Chemical analyses of the proximate compositions of the test ingredients were determined according to the procedure of AOAC (1995).

3.4.2 Feed Intake per Bird

The feed was weighed and provided regularly at 8.30 am every day and at the end of the day at 6.30 pm the remnants were put in a container and the cumulative weight is taken after 7 days.

Mean feed intake was calculated by the difference between the weight of offered feed and the remnants per week then divided by the number of birds in each group. All the experimental units were given the same amount of feed.

3.4.3 Weight Gain per Chick

The weight of the chicks was taken every 7 days for a period of 42 days using a digital weighing balance. For ease in weighing the chicks were put in a clean plastic bucket and this took place at 8 am on the 7th day before feeding took place.

Weight gain (expressed in grams) was calculated as the difference between the initial weight and successive body weights in successive weeks then divided by the number of birds in each group.

3.4.4 Feed conversion ratio (FCR)

This was calculated by dividing the amount of feed consumed (g) during the week by the gain in chick's weight (g) during the same week using the following formula

$$\text{FCR} = \frac{\text{Feed intake (g)/bird /week}}{\text{body weight gain (g) /bird/week}}$$

3.4.5 Cost per kg weight gain

Cost per kg weight gain was calculated as FCR x cost/kg of feed.

3.5 Data Analysis

The experiment investigated the effect of offering five types of CWP: SBM diets at various replacement levels to Kenbro chicks for six weeks. Data was summarized using MS Excel and analyzed using version 22 of SPSS package. All experimental birds survived throughout the study period.

4.1 Results

4.2 Nutritional Composition of the Feed ingredients

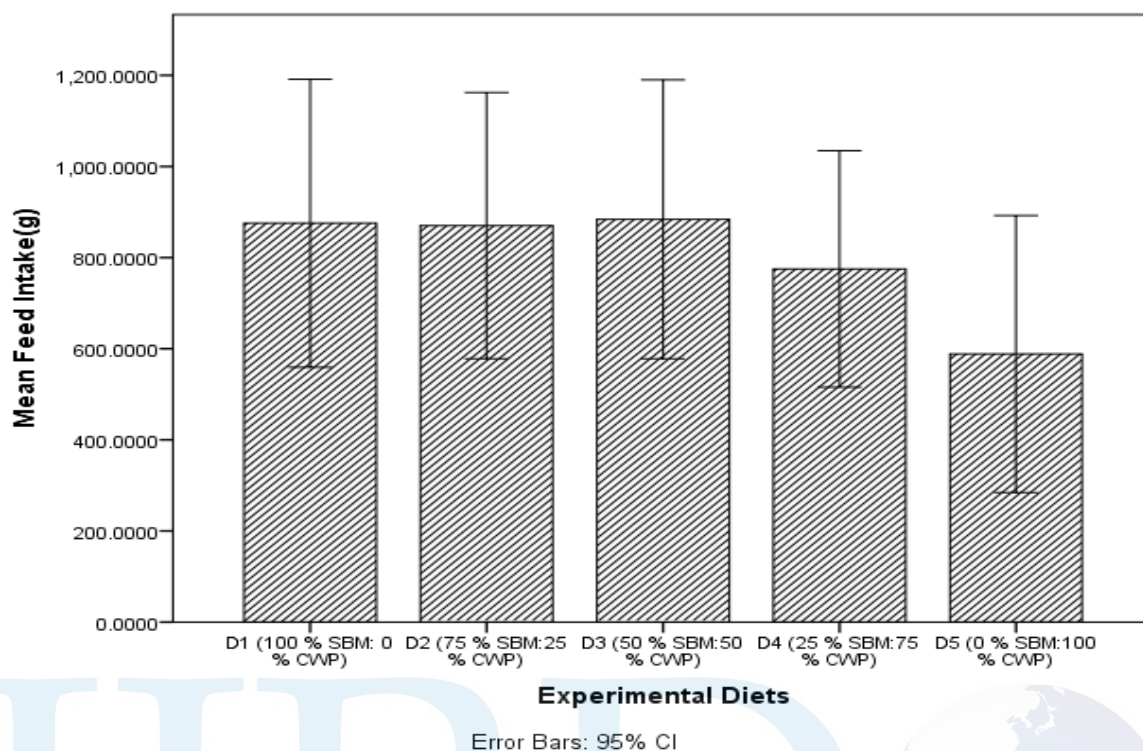
The results of the chemical analysis of the proximate composition of the best ingredients and the experimental diets (Table 4.2) done at the Kenya Dairy Institute laboratory of the Kenya Agriculture and Livestock Research Organisation (KALRO) and determined according to the AOAC (1995) were as shown below;

Nutrient composition	AS H(%)	DM (%)	CP (%)	Ener gy Kcal/kg	Crude Fibre (%)	Crude Fat (%)	Starch (%)	Lysi ne (%)	Methion ine(%)	P (%)	Ca (%)
CWP	3.72	88.80	24.63	2621.03	6.53	4.16	42.23	1.74	0.27	0.44	0.71
SBM	7.03	90.30	44.57	2536.84	8.08	2.35	44.39	3.04	0.71	0.79	1.20

The above findings are thus in agreement with those of Tshovhote et al.(2003) that the nutrient and energy concentrations of cowpeas compare well with those of soybeans , with fairly similar amino acid profiles, and often less expensive.

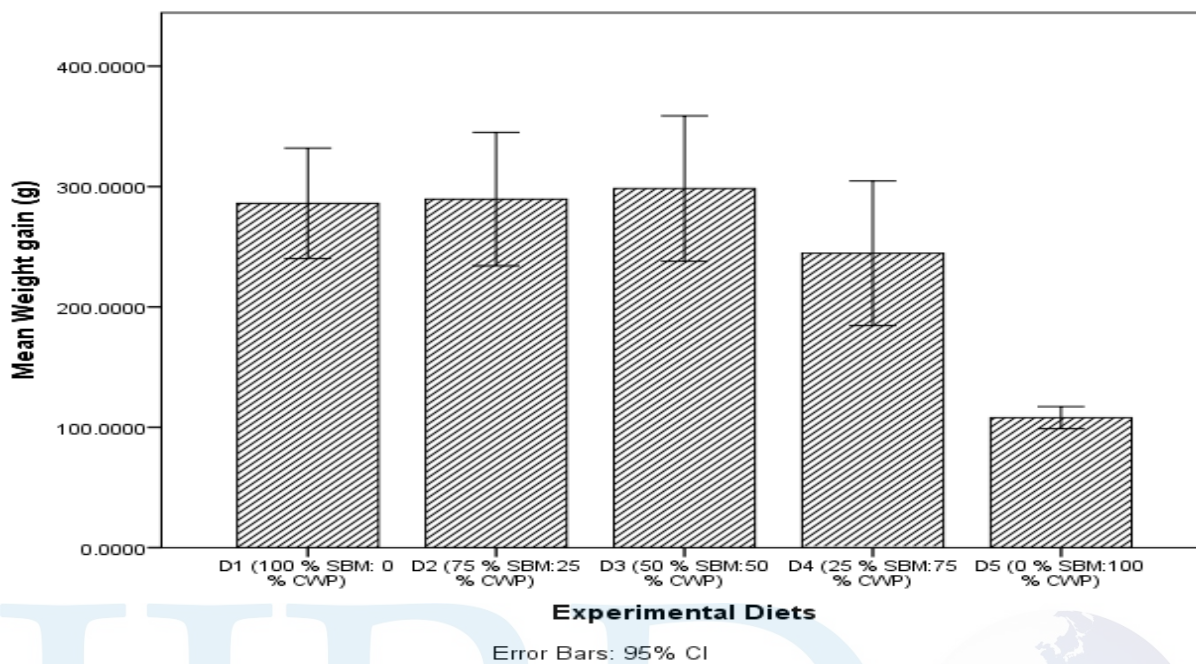
4.3 Feed Intake per Bird

Feed offered to the 8 chicks per experimental unit was weighed every day and at the end of the day the remnants were put in a container and the cumulative weight was taken after 7 days. From the figure below, it can be seen that mean feed intake for the Kenbro chicks due to the five experimental diets were fairly similar. The ANOVA which was used revealed that there negligible difference ($P>0.05$) between the mean feed intake due to the treatments which agree with the results reported by Chakam *et al.*, (2010).



Feed intake for birds however slightly declines when Soybean meal is replaced with 100 % Cowpea meal implying that at 0, 25, 50 % and 75 % replacement levels of CWP, the diets were all well received by the chicks since intake quantities were similar. The decrease in feed intake at 100 % CWP replacement levels may be due to the bulkiness and taste of the feed associated with high CWP levels compared with SBM. The poor feed consumption in the 100 % CWP replacement diets agrees with the findings of Amaefule & Osuagwu (2005).

4.4 Weight Gain per Bird



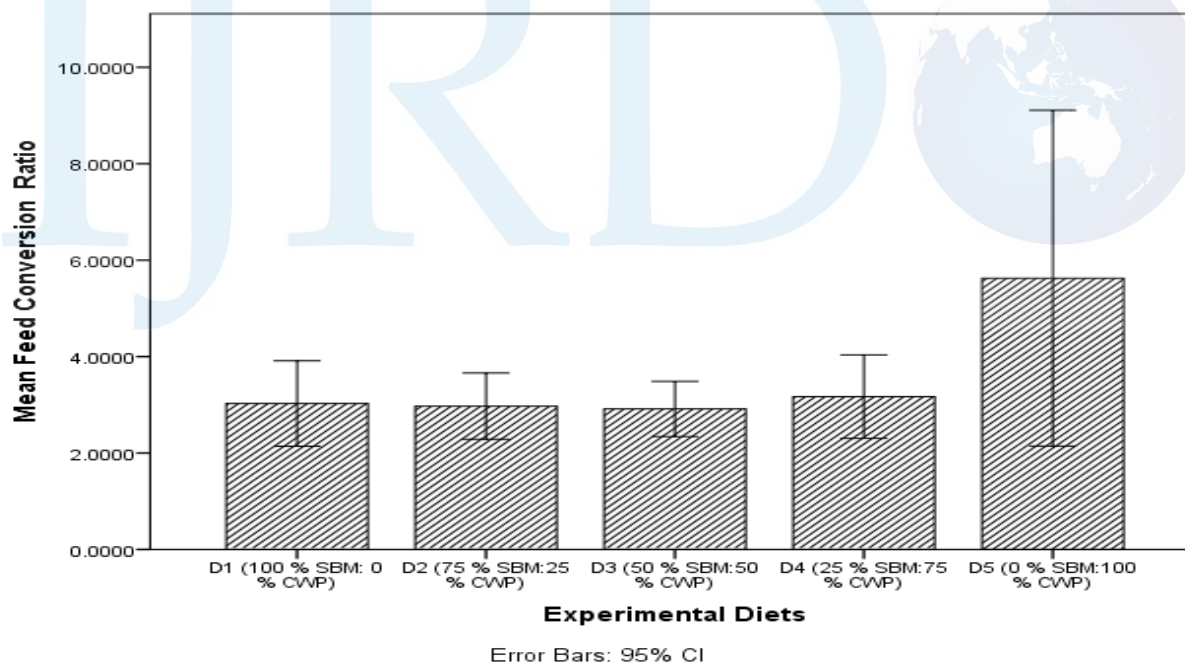
From the above figure, it can be seen that the mean weight gain for chicks fed 0, 25 %, 50 %, and 75 % CWP meal replacement levels were almost equal with 100 % CWP replacement level showing the lowest weight gain. The ANOVA conducted showed a considerable difference ($P < 0.05$) on mean weight gain due to the treatments. From the Duncan post hoc test below, it can be concluded that the mean weight gain was lowest for Diet 5 while for D1, D2 and D3 were highest.

Treatment	N	Subset	
		1	2
5	6	107.9653	
4	6		244.5347
1	6		286.0556
2	6		289.5278
3	6		298.3700
Sig.		1.000	.084

The observed mean weight gain is in agreement with the feed intake pattern of chicks which shows that at inclusion levels of 25 and 50 %, the CWP diets were capable of supplying adequate nutrients for a growth rate comparable to the control diet comprising 100 % (28 % of diet) SBM which is considered superior plant protein source.

4.5 Feed Conversion Ratio per Bird

From the figure below, it can be seen that the feed conversion ratio was fairly good for CWP inclusion levels of 0 %, 25 %, and 50 % while the diet with 100 % CWP inclusion level presented the poorest feed conversion ratio. From the ANOVA done, it can be concluded that there was a marked difference ($P < 0.05$) in Feed Conversion Ratio (FCR) because of the treatments.



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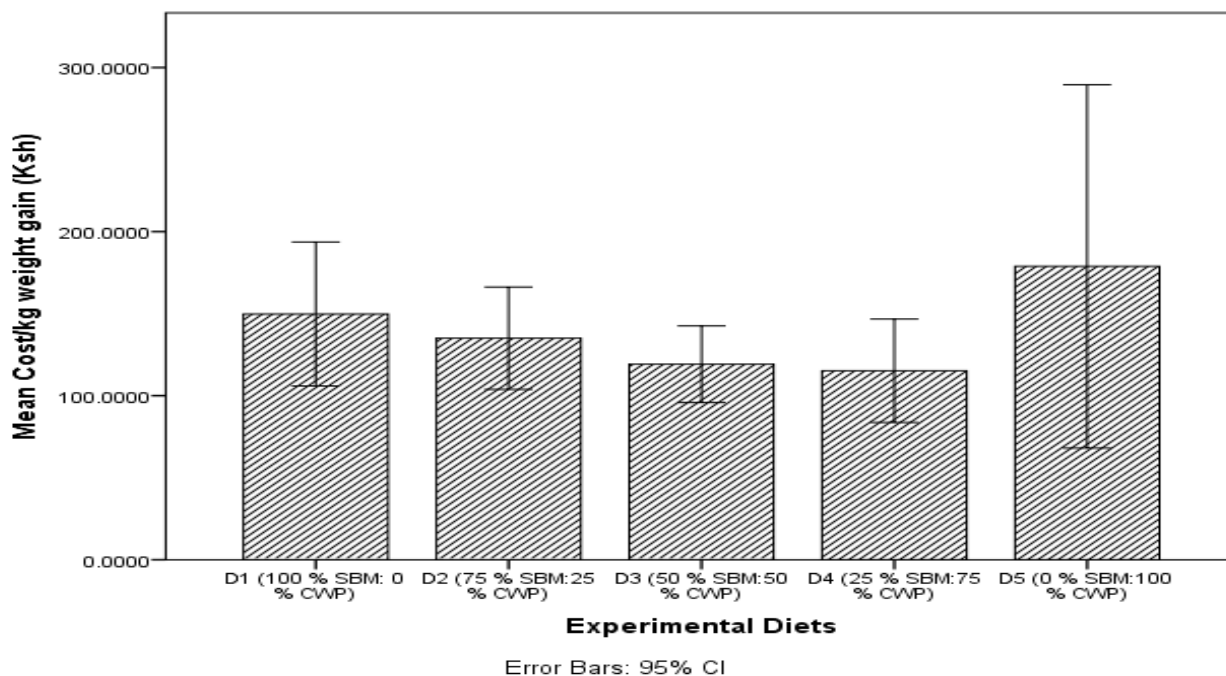
treatments. From the post hoc test done as shown below, it can be seen that feed conversion ratio was lowest for D5 while for D1, D2 and D3 it was fairly the same.

Treatment	N	Subset	
		1	2
3	6	2.9139	
2	6	2.9723	
1	6	3.0267	
4	6	3.1694	
5	6		5.6254
Sig.		.806	1.000

The results obtained for FCR in the control, 25 % and 50 % CWP replacement diets compared favorably to the results obtained by Tegua, Japou & Kamsu (2003) who fed broiler birds with raw cowpea and raw black common bean.

4.6 Costs per kg Weight Gain

From the figure below, the cost per Kg weight gain was lowest for D4 while for D5 (0 % SBM + 100 % CWP) it was highest. From the analysis of variance, it was found that $P > 0.05$ and therefore there were no significant differences between the cost per weight gain of the chicks due to the 5 experimental diets. The high cost of feeding is one of the problems of poultry farmers (Smith, 1990). It is generally assumed that when birds eat more, they have higher body weight at market age (Urdaneta-Rincon & Leeson, 2002); as demonstrated in all the experimental diets.



The 75 % CWP replacement diet achieved the best cost per kg weight gain and therefore posted the most attractive relative benefit to the Kenbro bird producers. As feed costs represent 60-70 % of the total cost of broiler production, the efficient conversion of feed into live weight is essential for profitability.

5.1 Conclusions

Based on the nature and results of the study; the following conclusions can be drawn;

- (i) Cowpea meal can replace up to 50 % SBM (14 % of the diet) as an alternative cheaper plant protein source in Kenbro diets at 3-9 weeks of age as at this level of replacing Soybean, satisfactory and positive effects were seen.
- (ii) Cowpeas can be an excellent source of dietary protein in animal nutrition, especially where animal proteins are in short supply and expensive. Although the protein level of cowpeas is lower than soya beans, they can offer an alternative to the often scarce and relatively expensive soya bean meal under tropical meat bird production systems thus greatly minimizing the feeding cost.

- (iii) The increase and development of cultivation of cowpea can play an important role in the industry of poultry feed in Kenya. Use of cowpeas in feeds of poultry diets can help reduce the losses which farmers incur due to damage by weevils.

5.2 Recommendations

Strengthening of animal nutrition research should focus on utilization and processing of cowpea as protein foodstuff. This will enable it to be properly evaluated as a source of protein and other nutrients for incorporation in poultry diets. The Government should promote cultivation and intensification of plant proteins such as Cowpeas, especially in the dry parts in order to increase supply and availability of plant proteins for use by the poultry feed industry.

REFERENCES

