REPUBLIC OF KENYA

KALRO
Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

TYPES AND ASSESSMENT OF QUALITY OF SOME INGREDIENTS FOR MIXING AFFORDABLE FEED RATIONS FOR IMPROVED INDIGENOUS CHICKEN

Introduction

The performance of chicken in terms of growth rates and egg production is highly dependent on the quality of ingredients used in mixing of the feed rations. These ingredients are expected to provide the required nutrients. Thus sources of energy, crude protein, minerals (major and trace elements), and vitamins are needed. Some ingredients used in the mixing of chicken rations are acquired from farms, while others are from industrial sources. The quality of ingredients used in laying chicken rations varies depending on factors such as the source of the materials, processing, and storage conditions.

Types of ingredients

Ground maize: Maize, a cereal crop, serves as a rich source of energy in livestock feeds. Ground maize (refer to Figure 1) is the product of dry milling whole maize grains through a grade 2 sieve in a hammer mill.

Figure 1. Ground maize

White sorghum: Sorghum is primarily grown for human consumption but can also be used as livestock feed depending on availability and cost. There are two types: brown (bitter) and white (very palatable). Nutritionally similar to maize, sorghum can be used to replace maize in compounded livestock feed.

Wheat bran: This by-product is obtained during the milling process of wheat for human consumption. It is characterised by a low energy value and a high crude fibre content.

Wheat pollard: Wheat pollard consists of part of the endosperm, germ, bran particles, and some flour, accounting for 40% of milling by-products. It's appearance is that of a brownish, finely ground meal. It is low in fibre, high in protein and energy, making it very suitable for pigs and poultry.

Maize germ: This is a milling by-product obtained after extracting oil from the embryos of maize grain. It serves as a crucial source of energy and protein in livestock feeds.

Soya bean cake: This by-product is obtained after extracting oil from soya bean seeds. It is highly digestible, a good source of protein, and is rich in lysine.

Figure 2. Soya bean meal

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Sunflower seed cake: Sunflower seed cake is obtained after mechanically extracting oil from the seeds. Sunflower seed cake meal is derived after grinding the sunflower seed meal. It serves as a protein source but is deficient in lysine and methionine.

Cotton seed cake: Cotton seed cake is obtained after pressing oil from cotton seeds, either mechanically (cotton seed cake) or through solvent

(cottonseed meal). When laying hens are fed cotton seed cake, gossypol affects egg quality; therefore, feeding cotton seed cake to layers is not recommended.

Fish meal: In Kenya, "omena" (*Rastrineobola argentea*) forms the main source of fish meal. It is an excellent source of highly digestible protein, energy, minerals, vitamin B and lysine.

Shrimp meal: In Kenya, "ochong'a" **(***Caridina nilotica)* is the dried by-product of the shrimp processing industry, consisting of soft tissues and shells of shrimps and prawns.

Black soldier fly (*Hermetia illucens*) has five developmental stages: egg, larval, pre-pupal, pupal, and adult. Larvae, for feeding chicken, are harvested at the pre-pupal stage.

Methionine and Lysine: Proteins consist of long chains of 20 amino acids, categorized as either "essential" or "non-essential." Animals cannot synthesize the "essential" amino acids, such as methionine and lysine, and these must be provided in their diet. Synthetic sources are sold as DL-Methionine and L-Lysine HCL, respectively.

Minerals: Minerals are crucial in the diet of laying birds as they are essential for optimal health, bone, and egg shell formation. They are classified into major and trace elements based on their concentration in the animal or the amounts required in the diet. Major elements include calcium, phosphorus, potassium, sodium, chlorine, sulphur, and magnesium. Trace elements include iron, zinc, copper, molybdenum, selenium, iodine, manganese and cobalt. Calcium and phosphorus are vital for poultry farming, necessary for skeletal growth and egg production. Excessive amounts of some minerals may interfere with the absorption or utilization of others. For example, high levels of calcium can interfere with phosphorus, magnesium, and zinc utilization. Some minerals can be toxic if in excess; for instance, sodium chloride in compounded feed for laying hens must not exceed 0.5 percent. Limestone is a rich source of calcium, and dicalcium phosphate (DCP) serves as a source of calcium and phosphorus.

Premixes: Most minor elements and some vitamins are provided in the form of commercial premixes. While using commercial premixes it is important to note that premixes are livestock species specific and age-category specific**.**

Toxin binders: Toxin binders are additives in feeds. An additive is an ingredient added in very small quantities during mixing feeds to fulfil a specific need. Toxin binders are important because they bind and inactivate aflatoxins in animal feeds. Aflatoxins are toxic compounds produced mainly by *Aspergillus flavus* and *A. parasiticus* moulds (fungi). Animals fed on aflatoxin-contaminated feed can pass aflatoxin transformation products into eggs, milk and meat. Children are particularly affected by aflatoxin contaminated food as it causes stunted growth, liver damage and cancer.

Assessment of Quality of Ingredients

To ensure good quality ingredients:

1. Do not use ingredients whose expiry date is passed or unknown.
2. Inspect the ingredients for any foreign material (for example, metal filings in sunflower seed cake meal), damage by insects, moulds, loss of natural colour and any other abnormalities.
3. Smell ingredients to detect any rotten material or unusual odour.
4. Feel ingredients for caking, dampness, bad texture, hardness, warmth and any other abnormalities.
5. Assess chemical composition of ingredients; collect about 100 grams of a sample of each ingredient (ground maize, wheat bran, maize germ, sunflower seed cake meal, soya bean meal, fish meal etc) and also the final mixed ration and put in separate khaki bags. Label the khaki bags (name of farmer, contact details, sample type, and date of sampling) and submit for chemical composition assessment in an animal nutrition laboratory. The cost of assessment of contents (% dry matter, total ash, crude protein and crude fibre) is about KES 1,000 per sample at KALRO centres.

After incorporating the cost of courier services (approximately KES 200 per parcel), the total expense for chemical composition assessment in a laboratory might seem prohibitive. However, the benefits of using high-

quality ingredients in ration mixing far outweigh the costs associated with laboratory assessment of the ingredients. Furthermore, costs can be minimized by purchasing ingredients in bulk at the lowest possible cost, thereby reducing the number of samples needed for analysis before mixing. Once the laboratory results are available, assess whether the ingredients are suitable for use in ration mixing. Table 1 shows the expected average chemical composition of the ingredients.

Careful consideration of the inclusion levels (Table 1) of the ingredients during ration formulation is crucial. This consideration significantly influences the performance of the chicken in terms of growth rate and egg production, ultimately impacting the profitability and household incomes.

Table 1. Maximum inclusion levels and chemical composition of ingredients for feed rations for indigenous chicken

Ingredients	Max inclusion level (%)	Metabolizable Energy (Kcal/kg)	Crude Protein (%)	Calcium (%)	Available Phosphorus (%)	Crude Fibre (%)	Lysine (%)	Methionine (%)
Maize	70	3420.0	8.20	0.04	0.15	3.36	0.24	0.17
White Sorghum	60	3412.7	10.80	0.03	0.10	2.80	0.24	0.10
Wheat bran	15	1818.2	17.31	0.10	0.56	11.24	0.60	0.10
Wheat pollard	20	2700.0	16.00	0.13	0.40	7.50	0.48	0.16
Maize germ	20	2942.6	10.67	0.04	0.47	6.59	0.61	0.28
Sunflower seed cake	5	2315.0	23.70	0.39	0.25	36.21	0.92	0.64
Cotton seed cake	5	2177.0	37.40	0.22	0.60	17.50	1.61	0.67
Soya bean meal	30	2583.7	53.49	0.20	0.20	3.59	2.70	0.60
Fish meal [Omena] (*Rastrineobola argentea*)	5	2,955.0	48.40	4.20	2.80	0.00	4.60	1.70
Shrimp meal [Ochong'a] *Caridina nilotica*	5	2566.7	43.51	11.50	3.00	14.30	2.20	0.96
Black soldier fly (BSF) larvae - dried, full fat	30	3964.0	41.10	0.80	0.61	7.00*	2.71	0.87
Dicalcium phosphate (DCP)	1	0.0	0.00	23.00	18.00	0.00	0.00	0.00
Limestone	9	0.0	0.00	34.00	0.00	0.00	0.00	0.00
Iodised salt	0.25-0.50	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Vitamin/Mineral premix	0.25	0.0	0.00	0.00	0.00	0.00	0.00	0.00
DL-Methionine	0.05	5020.0	58.10	0.00	0.00	0.00	0.00	99.00
L-Lysine HCL	0.10	4120.0	94.40	0.00	0.00	0.00	78.00	0.00
Coccidiostat	0.006	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Toxin binder	0.15-0.30	0.0	0.00	0.00	0.00	0.00	0.00	0.00

*Mainly Chitin from BSF exoskeleton

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