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Proximate analysis and chemical composition of *Moringa oleifera* seeds and its use in broilers diet

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Abstract
The present study was conducted to evaluate the chemical composition of *Moringa oleifera* seed meal and its uses in poultry diet. Results on the chemical composition of *Moringa oleifera* seed meal showed that the full fat seeds contained on proximate basis, reasonable concentration of 93.57 dry matter, 6.43% moisture, 95.55% organic matter, 43.26% crude protein, 12.08% crude fibre, 21.36% ether extract, 4.45% ash and 12.42% nitrogen free extract. Calcium and phosphorous value in *Moringa oleifera* seeds were 357.78mg/100g and 127.60mg/100g, respectively. The Ca/P ratio was high in *Moringa oleifera* seed meal. The ME value of seed meal was 3859.92kcal/kg. The obtained data of proximate analysis of *Moringa oleifera* seed meal revealed that the seeds are good sources for protein, fat, ash and also crude fiber.

Keywords: *Moringa oleifera* seed meal, organic matter, crude protein, proximate analysis

Introduction

Moringa is a tropical plant belonging to the family Moringaceae that grows throughout the tropics. A single genus with 14 known species, *Moringa oleifera* is the most widely known and utilized of these (Morton, 1991) [20]. *M. oleifera* is native to sub-Himalayan tracts of northern India and is commonly referred to as “horse radish tree” or “drumstick tree”. Moringa is a multipurpose tree of significant economic importance, as it has vital nutritional, industrial, and medicinal applications. The tree widely grows in the sub-Himalayan ranges of India, Sri Lanka, North Eastern and South-western Africa, Madagascar and Arabia.

Moringa oleifera thrives well in both tropical and subtropical climates under hot, humid and wet conditions with rainfall in excess of 3000mm/annum. Moringa grows in a variety of soil conditions ranging from sandy or loamy to heavy clays. The tree can be planted for forage production under intensive farming systems and can yield up to 3.0 tonnes seed/ha. Pod bearing start 6-8 months after planting. However regular bearing starts after the second year and can go for up to 40 years. Moringa plant is drought resistant and will grow even during the dry season. Owing to its drought tolerance, the tree is most suitable in those areas where the costs associated with production of commercial crops are high and can therefore be a valuable source of animal feed. Farmers consider Moringa as one of the most useful trees, as almost every part of the tree can be used for food, or have some other beneficial property as medicine or livestock feed.

Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods and seeds. Moringa is also rich in carotene, ascorbic acid, iron and in the two amino acids generally deficient in other feeds, i.e. methionine and cystine (Makkar and Becker, 1996) [17]. Every part of M. oliefera is edible and the leaves, roots, seeds, root-bark, stem-bark and pods have medicinal properties. The leaves, flowers and pods are used as good sources of vitamins A, B and C, riboflavin, nicotinic acid, folic acid, pyridoxine, ascorbic acid, beta-carotene, calcium, iron, and alpha-tocopherol (Dahot, 1988) [11]. Moringa seeds have high levels of lipids and proteins, with minor variations. The major saturated fatty acids present in the seeds are palmitic, stearic, arachidic and benic acids (Abdulkarim *et al*., 2005) [2]. Oleic acid is the main unsaturated fatty acid whose high concentration is desirable in terms of nutrition and stability during cooking and frying. Moreover, as a natural source of benic acid, the moringa seed oil is used as a solidifying agent in margarines and other foodstuffs containing solid and semi-solid fat, thus eliminating hydrogenation processes (Makkar and Becker, 1999; Francis *et al*., 2001) [18, 14].

The relative lack of anti-nutritional components and the high protein, lipid and sulphur containing amino acid contents encourage the use of moringa seed as an animal feed. It contains fiber, fats, mineral, proteins and vitamins like A, B, C and amino acids (Rock wood *et al*., 2013, Thurber and Fahey, 2010) [26, 28]. PUFAs are linolenic acid, linoleic acid and oleic acid; these PUFAs have the ability to control the cholesterol. Research show that Moringa seed oil contain around 74% PUFAs, making it ideal for use as a substitute of olive oil (Lalas and Tsaknis, 2002) [16]. It is an excellent source of proteins for monogastric animals (Ferreira *et al.*, 2008) [13].

The use of *Moringa oleifera* seed meal in poultry feeding

M. oleifera is a highly valued food plant characterized by a multipurpose use (Anwar *et al*. 2007) [6, 7], and Abbas (2013) [1] reviewed the use of this tree in poultry diets. Furthermore, *M. oleifera* seeds have been reported as good sources of the main feed ingredients including fats, proteins and minerals (Compaore *et al*. 2011). *M. oleifera* can play an important role in the economy of poultry industry.

In this study, the chemical/nutritional composition and evaluation of *Moringa oleifera* seeds obtained from the local market of Udaipur, Rajasthan state was determined to further compliment available data and information on the wonder tree.

Materials and Methods

Collection of *Moringa oleifera*

The seeds of *Moringa oleifera* seeds were procured from the local market of the Udaipur.

Preparation of *Moringa oleifera* seed meal

The seeds of *M. oleifera* were sorted out manually before soaking in water for overnight and rinsed with water in next morning till free from the foamy water. Then Moringa seeds were dried and ground in a domestic blender to obtain *Moringa oliefera* seed meal (MOSM).

Proximate analysis of *Moringa oliefera* seed meal

The proximate composition of the *Moringa oleifera* seeds was determined as described by AOAC (2005). The sample was analyzed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE), mineral matter (total ash) while gross energy (kcal/g) was estimated by calculation using the formula by Carpenter and Cleg (1956) [9]. Carbohydrate (NFE) was determined by difference.

Estimation of moisture Content

2 g of the powdered sample was weighed in a beaker of known weight. The sample was then placed in hot air oven at 105°C for 3 h. The sample was cooled and weighted again to determine water loss in powdered sample.

Estimation of fat content

The apparatus used for estimation of fat is Soxhlet extractor. To determine the percentage of fat the dried sample of plant was extracted with petroleum ether. It was then distilled off completely and dried. The oil weight and percentage of oil was calculated.

Estimation of crude fiber

During the acid and subsequent alkali treatment, oxidative hydrolytic degradation of native cellulose and considerable degradation of lignin occurs. The residue obtained after final filtration was weighed, incinerated, cooled and weighed again. The loss in weight is the crude fiber content.

Estimation of ash Percentage

For estimation of ash, the sample was incinerated at higher temperature. Briefly, 2 g of sample in a crucible was incinerated in to the Muffle furnace at 600˚C for 5 hours. The crucible was then cooled, the sample was reweighed and the percentage of ash calculated.

Estimation of Nitrogen percentage

The Kjeldahl method was used for Nitrogen estimation. Sample was digested by with concentrated sulfuric acid in the presence of digestion mixture. The ammonia was distilled by the addition of excess sodium hydroxide. Released ammonia was collected in boric acid and titrated with standard hydrochloric acid using methylene blue as an indicator. Total protein was calculated by multiplying nitrogen percentage by 6.25.

Determination of Nitrogen Free Extract

This was determined by calculation using this formula.

NFE = 100 – (%CP +% CF + %EE + %Ash+%moisture)

Estimation of Ca and P

Calcium and phosphorous value in *M. oleifera* seed meal was determined by Talapatra (1942) method.

Determination of ME value

The ME value of *M. Oleifera* seed meal was calculated by the equation of Pauzenga (1985) [30].

Table 1: Chemical analysis of *Moringa oleifera* seed meal

S.N.	Proximate analysis	%
1.	dry matter	93.57
2.	moisture	6.43%
3.	organic matter	95.55%
4.	crude protein	43.26%
5.	crude fibre	12.08%
6.	ether extract	21.36%
7.	ash	4.45%
8.	nitrogen free extract	12.42%
9.	ME value	3859.92kcal/kg
10.	Ca/P ratio	2.80mg/100g
11.	Calcium	357.78mg/100g
12.	phosphorous	127.60mg/100g

Result

Result of proximate analysis of *Moringa oleifera* seed meal have been presented in Table 1. *M. Oleifera* seed meal had 93.57 dry matter, 6.43% moisture, 95.55% organic matter, 43.26% crude protein, 12.08% crude fibre, 21.36% ether extract, 4.45% ash and 12.42% nitrogen free extract. Calcium and phosphorous value in *M. oleifera* seeds were 357.78mg/100g and 127.60mg/100g, respectively. The Ca/P ratio was 2.80mg/100g in *M. oleifera* seed meal. The ME value of *M. oleifera* seed meal was 3859.92kcal/kg.

Discussion

The low moisture content in the Moringa samples observed in this study is an indication that the activity of the microorganisms would be reduced and thereby increases the shelf life of the Moringa seed meal. This observation is in agreement with the report of Adeyeye and Adejuyo (1994) [3] and Olitino *et al*. (2007) [23]. The dry matter value is in accordance to Ogbe *et al.* (2013) [22]. The high crude fat of the Moringa seeds suggests that the kernel is a good source of quality vegetable oil for both domestic and industrial purposes.

The crude fiber value of *M. oleifera* seed meal was lower than Verma and Nigam, 2014 [29]. The differences between the results of this and other studies could be attributed to variation in geographical conditions, soil composition, cultivation climate, ripening stage, the harvesting time of seeds and the extraction methods used. The protein value of *M. oleifera* seed meal was greater in the present study than reported by (34.73%) Verma and Nigam, 2014 [29]; (35.97%) Olagbemide and Alikwe, 2014 [24, 25]; (38.8%) Abdulkarim *et al*., 2005 [2]; (39.1%) Moreki and Gabanakgosi, 2014 [19] and (40.31%) Anhwange *et al*., 2004 [5] while lower than (44.14%) Hassan *et al.*, 2017. Seeds are a good source of proteins which should be exploited to determine their commercially viability.

The high Ca/P ratio observed in this study is of nutritional benefit, particularly for children and the aged who need higher intakes of calcium and phosphorus for bone formation and maintenance. Food is considered 'good' if the ratio is above one and 'poor' if the ratio is less than 0.5 while Ca/P ratio above two helps to increase the absorption of calcium in the small intestine (Niemann *et al*., 1992) [21]. The ash contents of M. *oleifera* seed meal were slightly higher than Annongu, 2014 [4] while lower than Fagwalawa *et al*. 2015 [12]. Variation in mineral composition of MOSM observed in the present study and other researchers could be attributed to different origin and sources of MOSM.

Conclusion

Based on the results obtained in this study, it could be said that *Moringa oleifera* seed is a good source of lipid, protein and essential minerals. Its nutritional potentials enable it to be useful in formulations and fortifications of animal feeds.

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