Research Article

Analysis of Nutritional Value of crab meal as feed supplement for Livestock and Poultry

Thavasi Alagan Vijayalingam* and Nakulan Valsala Rajesh

Veterinary University Training and Research Centre, Ramanathapuram, Tamilnadu Veterinary and Animal Sciences University, Chennai, India

Abstract

The nutritional values of Shell and legs (Crab meal ´S´) and Viscera and claws with flesh (Crab meal ´V´) collected from a sea food industry were analysed. Higher values of Crude Protein (33.55%), Ether extract (1.79%), Acid insoluble ash (11.61%) and gross energy of 2528 Kcal/kg were found in Crab meal ´V´. Higher level of Crude fibre (11.66%) and Total ash (47.14%) were found in Crab meal ´S´. The mineral analysis showed a higher level of calcium (19.45%) and Manganese (162.37 ppm) in Crab meal ´S´ and a higher level of iron (720.10 ppm), copper (96.58 ppm), Magnesium (2.45%) and Phosphorus (1.45%) in Crab meal ´V´. Out of 13 fatty acid components analysed, only the free fatty acid (5.21%), Linolenic acid (5.70%), Behenic acid (13.72%), Ecosapentaenoic acid (16.54%) and Docosahexaenoic acid (15.28%) were found to higher in Crab meal ´S´. However, Archidic acid was found only in Crab meal ´V´.

Keywords: Crab meal, proximate analysis, minerals, Fatty acids

***Correspondence**

Author: Raghvendra Pratap Singh

Email:

vutrc_ramnad@tanuvas.org.in, tavijayalingam@gmail.com

Introduction

Ramanathapuram district is the south eastern most part of the state Tamil Nadu which holds an area of 4175 km^2. This district had the Gulf of Mannar Biosphere Reserve, first mega marine biodiversity of the country extending from Rameswaram to Kanyakumari. Although, this district is a highly draught prone one, the basic livelihood for the people of this district is agriculture. The people are running their occupations related to agriculture, animal husbandry and fishing activities. The agriculture and allied activities depend mostly on annual rainfall which is very sparse here. Hence, majority of the farmers are depending on other allied activities like animal husbandry and fishing. The hottest months of the year falls during the months of May and June. The rainy season begins from the month of August. The annual rainfall of this district during South-West monsoon is 136.1 mm and in North-East monsoon is 507.4 mm [1]. This district holds a sizeable number of livestock and poultry populations. As per the 19^{th} Livestock and poultry census details of 2012, the district had a cattle population of 85,843, Sheep population of 2,42,956, goat population of 2,24,388 and poultry population of 3,60,215 [2]. The livestock reared under these arid and dry regions require sufficient green fodder for grazing which could be only possible with availability of rainfall. In this situation, the cost of maintenance of livestock and poultry become a herculean task for the farmers. The cost of commercial feed is also costly and at times not readily available in the market. In this hard situation the farmers need to manage the show with own feed mixing with the easily available conventional or unconventional feed materials. Since, the wholesale rate of cereals, and protein rich oilcakes are also higher in the market, the farmers are compelled to look for a resource that is easily and abundantly available in the area. One such material available in and around Ramanathapuram and left unnoticed for a long time is crab industry waste consisting of the crab shell, legs and viscera. This district is estimated to catch about 5852.82 tonnes of crab every year [3]. In the total weight of crab about 50% will be considered as waste. It consists of the viscera, legs and shell and is being dumped into the environment causing pollution. Ferraro et al. [4] and Maria-Asuncion et al. [5] had reported that about 40% of materials from crab are being utilised for human consumption and the remaining 60% are being thrown as waste worldwide becoming hazardous to the environment. Maria-Asuncion et al. [5] also stated that the wastes being a high-protein and mineral rich source can better be utilized in livestock and poultry feed industry as a replacement for fish meal to augment body weight gain in animals and poultry and also increase milk, meat and egg production.

Considering the large availability of these crab waste and lack of feed material for the growing numbers of livestock and poultry in this district a small step was taken to understand the nutritive value of this abandoned stuff. The results were encouraging and hence are being presented hereunder in this small manuscript for the effective consideration of the scientific, industrial and farming community. However, a detailed study has to be undertaken to

throw light on the amount to be incorporated in feed and the type of further treatment required, if any, prior to their incorporation in the livestock and poultry feed.

Materials and Methods

The study was carried out during March, 2020. Crab wastes were obtained from a crab by-product processing small industry at Therkutharavai village, Ramanathapuram District. Two types of materials *viz.* Shell and legs (Crab meal 'S') and Viscera and claws with flesh (Crab meal 'V') were collected. The materials were sun dried and pulverised into meal using a rotary grinder. Proximate analysis was carried out as per standards of Association of Official Agricultural Chemists (AOAC) [6]. Six mineral components *viz.* Calcium (%), phosphorus (%), iron (ppm), copper (ppm), manganese (ppm) and magnesium (%) and 13 fatty acid components like free fatty acids (%), myristic acid (%), palmitic acid (%), stearic acid (%), oleic acid (%), linoleic acid (%), linolenic acid (%), arachidic acid (%), behenic acid (%), ecosapentaenoic acid (%), docosahexaennoic acid (%), palmitoleic acid (%) and other fatty acids (%) were tested in Crab meal 'S' and Crab meal 'V'. The nutritional analysis was performed at Animal Feed Analytical and Quality Assurance Laboratory (AFAQAL), Namakkal, a constituent unit of Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai and the results were interpreted.

Results and Discussion

The comparative study on the proximate composition, mineral and fatty acids composition of two forms of crab meal were given in (**Table 1**). The analysis showed a higher level of Crude Protein (33.55%), Ether extract (1.79%), Acid insoluble ash (11.61%) and gross energy (2528 Kcal/kg) content in crab meal 'V' (Viscera and claws with flesh). Crab meal 'S' showed a higher level of Crude fibre (11.66%) and Total ash (47.14%). None of the crab meal samples showed an uniformity of Ca:P ratio and there was a wide variation in Ca:P ratio (6:1 to 16:1). The results were in accordance with the earlier reports [7-9] which stated that the crab processing waste are an excellent source of crude protein ranges from 40 to 45% on dry matter basis. Lubitz et al. [10] reported a lower fat content (0.8%) and higher ash content (41.6%) in crab processing waste. The result of the present study too showed the similarity in the values especially in meal 'S'.

Present study showed very higher in Ca and lower in P (Table 1) concentration in the crab meal. The higher level of Ca in crab waste has been indicated as a limiting factor to its use as animal feed [10-12]. Lovell et al. [11] recommended inclusion of not more than 10% of crab meal waste in the animal diet. Patton et al. [13] showed that feeding 20% crab meal to ruminants showed no untoward effects in body weight gain, feed intake or feed efficiency. Similarly, Parkhurst et al. [14] reported lesser growth but more egg pigmentation in chickens fed with crab meal compared to fish meal. It is assumed that, the crab meal meant in the earlier studies might be of only shell and leg meals. If it mixed with viscera and flesh meal, in this study the crab meal 'V' definitely the growth and production would not had been much altered due to its high protein content of about 30-35%. But the crab meal could not be a complete replacer for the fish meal which was understood to have more than 60% of crude protein. The fish meal usually had 17 to 25% total ash and 'S' meal in this study had 47.14% and the 'V'meal had only 11.61 almost nearer to the fish meal. Hence, the crab meal with viscera and flesh could be incorporated either as a replacer for fish meal or along with fish meal to reduce the feed cost without much altering the quality of the feed. However, steps are to be taken to adjust the higher mineral contents in the crab shell meal ('S' meal in this study) especially Ca (Calcium) and P (Phosphorus) ratio for better utilisation. And this type of meal can be incorporated in poultry in laying stage which could take care of the Ca and P deficiency during that physiological phase. Richardson et al. [15] reported that inclusion of crab meal without altering calcium content in the diet led to cataracts, nephrocalcinosis, and suppressed appetite, general decline in growth rates, increased mortality and diminished zinc bioavailability. Delgado et al. [16], IFFO [17] and Leeson and Summers [18] opined that chickens could be fed with crab meal supplementation as they require high dietary ash requirements and moreover the chickens also having the endogenous digestive chitinase [19, 20] to digest the polysaccharide chitin or chitosan present in the crab meal.

Although Crab meal contains all essential amino acids for chickens and fishes, the protein requirement may not be complete for chickens and fishes due to the relatively low amount of lysine and tryptophan. Therefore complete replacement of fishmeal in formulated diets may not be possible without tryptophan and lysine supplementation. In this present study the essential amino acid is not analysed which could be studied further during the feed trial assessment in poultry.

The mineral analysis showed a higher level of Manganese (162.37 ppm) in Crab meal ´S´ and a higher level of iron (720.10 ppm), copper (96.58 ppm) and Magnesium (2.45%) in Crab meal ´V´. Analysis of 13 fatty acid components in these two crab meal showed a higher level of free fatty acids (5.21%), Linolenic acid (5.70%), Behenic acid (13.72%), Ecosapentaenoic acid (16.54%), Docosahexaenoic acid (15.28%) and others (28.39%) in Crab meal

´S´ and a higher level of Myristic acid (1.96%), Palmitic acid (17.86%), Stearic acid (6.78%), Oleic acid (16.62%), Linoleic acid (8.95%) and Palmitoleic acid (2.52%) in Crab meal ´V´. However, Archidic acid (2.48%) was found only in Crab meal ´V´. Chicken feed needs ω-unsaturated fatty acids for normal growth and development. For poultry, linoleic acid (18:2ω6) and linolenic acid (18:3ω3) are essential fatty acids. Chickens and chicks fed with a diet deficient in linoleic acid (< 1% of the diet) will suffer retarded growth, an increased water requirement, fatty liver, reproductive difficulties, and immune insufficiency [21]. Laying hens can require up to 5% dietary linoleic acid for egg production [21, 22]. In this present study the linoleic acid is comparatively higher in Crab meal ´V´ (8.95%). Chickens also require linolenic acid in their diet for production of Ecosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA). The notably high linolenic acid level in Crab meal would make it a good source for chicken feed. In this present study Crab meal ´S´ contains a higher level of Ecosapentaenoic acid (16.54%) and Docosahexaenoic acid (15.28%) when compared to Crab meal ´V´ which showed a lesser Ecosapentaenoic acid (9.43%) and Docosahexaenoic acid (9.49%). This reduced level of two omega-3-fatty acid components in Crab meal ´V´ might be attributed to lesser content of Linolenic acid (0.72%).

Table 1 Comparative study on the proximate composition, mineral and fatty acid composition of various forms of Crab Meal

S. No	Test	Crab Meal 'S'	Crab Meal 'V'
1.	Moisture	9.85%	18.00%
2.	Crude Protein	15.72%	33.55%
3.	Crude Fibre	11.66%	5.18%
4.	Ether Extract	0.57%	1.79%
5.	Total Ash	47.14%	35.08%
6.	Acid Insoluble Ash (Sand and Silica)	5.01%	11.61%
7.	Salt	2.21%	3.60%
8.	Gross Energy	2011 Kcal/kg	2528 Kcal/kg
9.	Calcium	19.45%	9.28%
10.	Phosphorus	1.18%	1.45%
11.	Iron	724.10 ppm	764.85 ppm
12.	Copper	69.07 ppm	96.58 ppm
13.	Manganese	162.37 ppm	153.36 ppm
14.	Magnesium	2.21%	2.45%
15.	Free fatty acids	5.21%	4.06%
16.	Myristic acid	1.02%	1.96%
17.	Palmitic acid	6.32%	17.86%
18.	Stearic acid	4.45%	6.78%
19.	Oleic acid	4.57%	16.62%
20.	Linoleic acid	3.15%	8.95%
21.	Linolenic acid	5.70%	0.72%
22.	Archidic acid	0	2.48%
23.	Behenic acid	13.72%	8.47%
24.	Ecosapentaenoic acid	16.54%	9.43%
25.	Docosahexaenoic acid	15.28%	9.49%
26.	Palmitoleic acid	0.80%	2.52%
27.	Others	28.39%	14.67%

Conclusion

Crab meal has favourable nutritional characteristics as feed supplement in chicken and fish feed. Crab meal 'V' in this study can even be utilised as the replacer for fish meal. Continuation of this work by dietary inclusions as feed supplement in poultry and livestock should be considered for further evaluation.

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