International Journal of Global Affairs, Research and Development (IJGARD), Vol.4, No.1, 753-769, ISSN 2992-2488

COMPARATIVE EFFECTS OF REPLACING SOYA BEAN MEAL WITH FISH MEAL IN THE DIETS OF BROILER CHICKEN ;A REVIEW

[1]Hassan, M A., [1]Francis, E.S., [2]Madaki, A.Y and [1]Zailani, J.H

[1]Department of Animal Science, Federal University, Kashere, Gombe State , Nigeria

[2]Department of Animal Health and Production Technology ,Yobe State College of Agriculture, Gujba Yobe Sytate , Nigeria

(**Corresponding Author**, Hassan, M.A, mohammedhassanalhaji@gmail.com ,08024568681)

ABSTRACT

The study reviewed the nutritional composition and implication of Soya bean meal replacement with fish meal in relation to broiler diet from various authors. Proximate composition of Soya bean was found to contained between; 8.07 to 10.50% moisture, 36.00 to 39.24% Crude Protein, 5.44 to 6.84% Crude Fiber, 18.40 to 30.31% Crude Lipid,4.29 to 5.10% Ash, and 4.10% to 16.31 Carbohydrate. The average mineralcontents (%) were found to be 0.5 and 3.0 (Na), 18.1 (K), 2.3 and 8.5 (Mg), 2.2 and 3.0 (Ca), 2.3 and 5.6 (P), 2.7 and 44.0 (Zn), 13.0 (Cu), 27.0 (Mn) and 10.6 and 11.9 (Fe). Mineral determination showed that fishmeal contained 11.9 mg/100g of Calcium, 11.8 mg/100 g of Magnesium, 3.7mg/100g of Iron, 45.4mg/100g of Sodium, 99.0 of Zincg/kg, 15.7mg/100g of Phosphorus. The Protein, fat, moisture, carbohydrate, ash and fibre content in the bodies of 6 fish species commonly used as protein sources were revealed. Statistical analysis using ANOVA showed significant differences in the values of the six parameters fishes studied (P<0.01). The study observed that, in terms of percentages, Protein content was highest in C. senegalensis (75.43 ± 0.20 %) and lowest in C. macrolepsis (64.25 ± 0.01 %). Fat content was found to be highest in S. nigrita (25.10 ± 0.30 %) and lowest in C. senegalensis (19.53 ± 0.20 %), moisture content was highest in S. nigrita (23.52 ± 0.02 %) and lowest in C. senegalensis (21.08 ± 0.01 %). Carbohydrate content was found to be highest in C. macrolepis (4.38 ± 0.02) and lowest in H. lineatus (1.52 ± 0.02 %). Ash content was highest in C. macrolepis (3.75 ± 0.02 %) and lowest in C. carassius (1.20 ± 0.20 %) while fibre content was highest in H. lineatus (2.30 ± 0.10 %) and lowest in C. senegalensis (1.09 ± 0.20 %). The result of this review can be used to advice farmers to make appropriate choices in the use of fish meal in replace to soya bean meal for formulating animal feed based on their nutritional requirement, particularly Monogastric Nutrition

Keywords: Soya beans, Mineral content, Nutritional value, Proximate composition, Fish meal

1.0 INTRODUCTION:

Leguminous plants contain high-quality protein and oil that are of paramount importance to animal nutrition. One primary source of high-quality protein and oil is the soya bean (Grieshop and Fahey, 2001). In fact, the quality of soya beans is usually determined by seed protein, oil, fatty acid, and mineral contents, as such its quality is key to improving human and animal nutrition. The soya bean, botanically called *Glycine max* (L.) originated from Eastern Asia, probably in north and central China (Food Labeling, 1999). Soya bean (Glycine max) has recently become popular in the West African sub-region due to their high protein content. It is an annual leguminous crop and is grown to provide food for humans, feeds for animals and raw materials for industries (Abbey, 2001). It has been widely documented that soybean seed composition varies with environmental factors, especially during the seed filling period when accumulation of the seed chemical components occurs (Wilson, 2004; Carrera *et al.*, 2009, 2011). The relationship of protein contents (the sum of all amino acids) with temperature

(Wilson, 2004) and water availability (Boydak *et al.*, 2002; Kumar *et al.*, 2006;

Fishmeal is made from fish that are ground, cooked, and processed. Fishmeal is an excellent source of protein for poultry. It has high levels of essential amino acids such as methionine and lysine, and it also has a good balance of unsaturated fatty acids, certain minerals (available phosphorus), and vitamins (A, D, and B-complex). (Jacquire j. 2020). Fish proteins are rich in essential amino acids particularly methionine and lysine in contrast to most proteins from plant sources, which lack adequate amounts of one or more essential amino acids. Fish proteins are considered nutritionally equivalent or slightly superior as compared with red meat. They are highly sensitive to proteolytic digestion, with high digestibility and a high biological growth promoting value (Nargis, 2006). The use of fish byproducts for feeding animals is not a new idea; a primitive form of fish meal is mentioned in the Travels of Marco Polo at the beginning of the fourteenth century: ‘they accustom their cattle, cows, sheep, camels and horses to feed upon dried fish, which being regularly served to them, they eat without any sign of dislike.’ The utilization of herring as an industrial raw material actually started as early as about 800 AD in Norway. A very primitive process of pressing the oil out of herring by means of wooden boards and stones was employed. Fish and its products is now a key food commodity for man's future survival (Effiong and Fakunle, 2011). It is one of the world's most important sources of animal protein preferred by most people (Chukwu, 2009). Due to the added non fish based nutrient it has which are all vital for human health

and growth (Centre of Excellence Science Seafood Health, 2011). Aside protein, fish has nutrients such as omega 3 long chain polyunsaturated fatty acids (n-3 LC-PUFAs), iodine, calcium, and vitamin D, zinc and iron (McManus and Newton, 2011).

The aim f this review is to compare the Nutritional composition and quality of Soya bean and Fish meal used in the diet of poultry

2.0 METHODOLOGY

Literature materials on the nutritive qualities of fish meal and soya bean meal as well as results of feeding trials with the two feed components were assembled from journals, conference proceedings , books and bulletins , they were thereafter reviewed, then discussed

3.0 REVIEW OF LITERATURE.

The protein quality of fishmeal for broiler diets varies based on the source of fish and the processing steps used to produce the meal, but most have about 62% to 75.4% CP, 7.9 to 21.08% moisture, 0.9 to 1.09 fibre, 9.20 to 38.3 lipids, 3.8 to 16.8 Ash and 4.3 to 4.5 carbohydrate in fishmeal as reported by NRC (2021), Banerjee et al., (1986) and C. Ndome et al., (2010)$_{1,}$ Table$_{2}$ 1 $_{3}$ (MV^{F} MV^{F} and MV^{F}). Compared to plant proteins such as soybean meal, fishmeal provides high-quality protein (Table 1). Fishmeal is also a good source of calcium and phosphorus for broiler, and nutrients are in a highly available form (Miles, 2011). Egg production, fertility, and hatchability have also improved with inclusion of fishmeal in the diet (Alemayehu, 2015). Poultry diets should generally be limited to no more than 10% fishmeal to prevent a fishy taste to the meat (Mavromichalis, I. 2018).

Proximate composition of

The sample of the ground soya bean seed was analyzed by NRC (2021), Bayero *et al*., (2019) and Ogbemudia *et al.,* (2017) for different proximate composition including moisture content, ash content, crude lipid content, crude protein content, crude fiber content, and carbohydrate content using different standard techniques in percentage, and the results are $_{1\ 2\ 3}$ presented in Table 1 (MV^{S} , MV^{S} and MV^{S}). The moisture content was found to be 8.07, 8.13 and 10.5% reported by NRC (2021), Bayero *et al*., (2019) and Ogbemudia et al., (2017). This low moisture content of soya bean is of advantage because it enables the seed to be stored for a very long time. A protein content of 36% to 39.24% was obtained in their research, and as contained in the

McGraw-Hill Encyclopedia of Science and Technology (2002) soya beans contain about 40% protein. the result tallies with the findings reported by Ogbemudia et al., (2017) who reported almost similar values of 37.69% but lower than in fishmeal reported by NRC (2021), Banerjee et al., (1986) and C. Ndome et al., (2010) Table 1 (MV^F MV^F and MV^F).

The fibre content of the soya bean sample was found to be 5.44 to 6.84% were higher than in fishmeal. Fibre has some physiological effects in the gastrointestinal, tract. These effects include variation in fecal water, fecal bulk and transit time and elimination of bile acids and neutral steroids which lower the body cholesterol pool and can also cut the risk of fibrosarcoma (Ogbemudia *et al*., 2017). The crude lipid content of 18.4, 28.2 and 30.31% were higher than in fishmeal in this study except the one reported by Bernerjee et al (1986) is an indication that soya bean may be an excellent source of oil, Banaszkiewicz, 2000; Ogbemudia et al., 2017. The observed results support the usefulness of soya bean seed like a good source of edible oils which can be used in cooking as well as soap manufacturing industry (Ogbemudia et al., 2017). According to report by Lokuruka (2010) soya beans have an ash content of about 5%, and this supports the finding of this reviewed (5.10%), with NRC 2021. Reporting an ash content of 4.16%. Bayero et al., 2019 but lower than in fishmeal as reported in Table 1. Generally, the results obtained in this study suggest that fishmeal can be a good source of protein, fat/oil and therefore should be exploited as commercial source to supplement both animal and consumption (i.e. Monogastric nutrition).

Table 1: Proximate Composition (%) of Soya bean seed compared to fishmeal

S/NO.	Component	MV^F1(%)	MV^F2(%)	MV^F3(%)	MV^S1(%)	MV^S2(%)	MV^S3(%)
1	Moisture	7.90	10.90	21.08	10.50	8.13	8.07
2	Crude Protein	65.20	62.30	75.43	36.00	39.24	37.69
3	Crude Fibre	0.00	0.90	1.09	5.60	6.84	5.44
4	Crude Lipid	9.20	38.30	24.60	18.4	30.31	28.20
5	Ash	16.80	14.50	3.80	5.10	4.61	4.29
6	Carbohydrate	4.51	4.40	4.30	4.10	5.08	16.31

MV^F1= Mean value of fishmeal 1 **Source:** NRC (2021).

MV^F2= Mean value of fishmeal 2 **Source:** Banerjee et al., (1986)

MV^F3= Mean value of fishmeal 2. **Source:** C. Ndome et al., (2010)

MV^S1= Mean value of soya bean 1**. Source:** NRC (2021).

MV^s2= Mean value of soya bean 2. **Source**: Bayero *et al*., (2019):

MV^s3= Mean value of soya bean 2. **Source:** Ogbemudia et al., (2017)

Bayero *et al.* (2019) investigated mature soya bean seeds in Kano Nigeria and obtained the Proximate compositions where the sample seeds were analyzed for different nutrients including moisture content, ash content, crude lipid content, crude protein content, crude fiber content, and carbohydrate content using different standard techniques, the results for the analysis of some mineral elements, including Na, K, Mg, Ca, P, Zn, Cu, Mn, and Fe, were also shown, using standard methods according to the Association of Official Analytical Chemists (AOAC ,1994).

Table 2: Mineral Content of the Soya Bean and Fishmeal

S/N	Mineral		FM1 (mg/100g)		FM 2 (g/kg)	SBM 1 (mg/100g)	SBM 2 (g/kg)
1	Na	45.4	10.6	3.00	0.5		
2	K	20.2	7.9	nd	18.1		
3	Mg	11.8	2.2	8.53	2.3		
4	Ca	11.9	41.3	217.38		3.0	
5	P	15.7	26.4	2.33	5.6		

6	Zn	Nd	99.0	2.70	44.0
7	Cu	Nd	11.0	nd	13.0
8	Mn	Nd	18.0	nd	27.0
9	Fe	3.7	3.5	11.86	10.6

Na= Sodiun, K=Potassium, Mg=Magnesium, Ca=Calcium, P=Phosphorus, Zn=Zinc, Cu=Cupper, Mn=Manganese, Fe=Iron**.** nd= not detected.

FM 1= Fishmeal 1**. Source:** Bernard et al., (2022) **FM 2=** Fishmeal 2**. Source:** NRC (2021)

SBM 1= Soya bean meal 1. **Source**: Eshun G. (2012) **SBM 2=** Soya bean meal 2**. Source:** NRC (2021)

The results for the analysis of some mineral elements, including Na, K, Mg, Ca, P, Zn, Cu, Mn, and Fe are presented in Table 2. Was carried out by Eshun G, (2012) and NRC (2021). According to NRC (2021), The mineral (calcium, magnesium, iron, zinc, sodium, and phosphorus) concentrations (g/kg) of the flour sample of the soya bean in which Zinc is highest value (44.0 g/kg) followed by Manganese 27.0 g/kg, Sodium had the lowest value of 0.5 g/kg of mineral. Calcium content of 3.0 g/kg obtained was far higher than range of values 2.2 mg/100g reported (Eshun G, 2012). The magnesium content 2.3 g/kg was also found lower than the range of values 8.5 mg/100g reported (Eshun G, 2012). The iron content of 10.6 g/kg was found lower than the values 11.9 mg/100g reported (Eshun G, 2012). The phosphorus content of 5.6 g/kg was far more than that of soya beans reported as 2.3 mg/100g (Eshun G, 2012). The variation in results may be due to the difference in specie used and the dictates of environmental conditions. The cupper, potassium and manganese was not detected by (Eshun G, 2012).

The mineral (calcium, magnesium, iron, zinc, sodium, and phosphorus) concentrations (g/kg) of the fishmeal samples in which Zinc is highest value (99.0 g/kg) than in soya bean as reported by NRC 2021, and Magnesium had the lowest value of 2.2 g/kg of mineral in fishmeal slightly lower than in soya bean meal according to NRC (2021). Iron has lower value in fishmeal according to Bernard (2022) and NRC 2021 (3.5-3.7) all lower than in Soya bean meal according to Eshun G, 2012 and NRC 2021. Calcium content of 3.0 g/kg obtained by NRC 2021 and 2.2mg/100g obtained by (Eshun G, 2012) was far lower than range of values 11.9-41.3 in fishmeal obtained by both Bernard 2022 and NRC 2021 respectively. The Sodium content of

45.4 g/100g and 10.6 in fishmeal reported by both Bernard 2022 and NRC 2021 was also found be higher than the range of values 0.5g/kg and 3.0mg/100g in soya bean meal reported by (Eshun G, 2012) and NRC 2021. The phosphorus content of 15.6 g/100g and 26.4g/kg obtained by Bernard 2022 and NRC 2021 was far more than that of soya beans reported as 2.3 and 5.6g/kg (Eshun G, 2012 and NRC 2021). Zinc, cupper and manganese has 99.0,11.0 and 18.0 in fishmeal reported by NRC 2021 but not detected by Bernard 2022, this may be due to the difference in specie used and the dictates of environmental conditions.

The incorporation of soya beans food into a diet could be an important means of preventing and treating some chronic diseases such as tumors (fibrosarcoma) and connective tissue diseases in birds (Prestamo et al., 2002), and it could be used in the management of protein deficiency cases (Ogbemudia et al., 2017).

TABLE 3: Proximate composition of some reviewed fishes

Proximate Composition (%)	C.senegalensis	C.nigrodigitatus	C.carassius	H. lineatus	C.macrolepis	S.nigrita
Moisture	21.08±0.01^{a}	21.30±0.10^{a}	22.65±0.01^{a}	22.90±0.10^{ab}	22.55±0.02^{a}	23.52±0.02^{b}
Ash	1.40±0.20^{a}	2.42±0.01^{b}	1.20±0.20^{a}	2.45±0.02^{b}	3.75±0.02^{c}	2.30±0.20^{b}
Protein	75.43±0.20^{a}	69.56±0.02^{b}	72.81±0.01a	70.87±0.02^{b}	64.25±0.01^{c}	66.50±0.02^{c}
Fat	19.53±0.20^{d,c}	23.40±0.10^{b,c}	20.40±0.10^{c,f}	22.65±0.05^{a,b}	24.60±0.10^{a}	25.10±0.30^{c,d}
Fibre	1.09±0.20^{a}	1.25±0.01^{a}	1.42±0.02^{a}	2.30±0.10^{b}	1.88±0.01^{b}	2.07±0.01^{a}
Carbohydrates	2.10±0.03^{a}	3.21±0.02^{b}	3.81±0.03^{c}	4.38±0.02^{c}	1.52±0.02^{d}	3.49±0.01^{b}

All values with the same superscript letters on the same row are statistically non-significant (ANOVA: P>0.05).
Source: C. Ndome et al, 2010.

However, in the use of fish meal, (Ndome et al, 2010) carried out an investigation between the months of April and July 2009 and revealed that six commonly eaten fish species, Cynoglossus senegalensis,

Chrysichthys nigrodigitatus, Carasssius carassius, Hydrocynus lineatus, Citharinus macrolepis and Synodontis nigrita, were good sources of dietary protein for the poultry. Analysis of protein, fats, moisture, carbohydrate, ash, and fibre were carried out in the University of Calabar, Nigeria using standard methods according to the Association of Official Analytical Chemists (AOAC ,1994). The data obtained were analyzed using ANOVA tests to determine the variability in the estimates of protein, fat, moisture, carbohydrate, ash and fibre content of replicate samples determined and recorded C. Ndome et al., 2010. In their study (Table 3.1) observed that, the average Percentage protein concentration was found to be highest in C. senegalensis (75.43%) and lowest in C. macrolepis (64.25%). Fat content was highest in S.nigrita (25.1%) and lowest in C. senegalensis (19.53%). Moisture content was highest in S. nigrita (23.52%) and lowest in C. senegalensis (21.08%). The Carbohydrate values ranged from 1.52% in H. lineatus to 4.38% in C. macrolepis. Ash content varied from 1.20% in C. carassius to 3.75% in C. macrolepis. Fibre content ranged from 1.09% in C. senegalensis to 2.30% in H. lineatus. However, their report indicated that when these values in the fish species studied were statistically compared using ANOVA, there was a significant difference ($P< 0.01$) in the moisture contents of the fishes. For ash, there was a significant difference ($P< 0.01$) in the values recorded for the fishes. The protein content was also significantly different ($P< 0.01$). Fat, fibre and carbohydrate contents were all significantly different ($P< 0.01$) in the fish samples analyzed. The specific species that varied significantly in these parameters have been determined using the Duncan's multiple range test and have been indicated with superscript letters in table 3.

However, because of their high fat (oil) content (>5%) which means a high calorie content per unit of protein, they may not necessarily be an ideal source of animal protein for use in some controlling diets. In *C. senegalensis*, the data showed that the protein content was the highest when placed side by side with the protein contents in other fishes in this study, whereas the values obtained for the other parameters (fat, fibre and moisture content) were relatively the least. The reverse was the case with *C. macrolepsis* which had the highest ash and carbohydrate content while the protein content was lowest relative to other species studied. With respect to *C. nigrodigitatus*, the six parameters investigated revealed that they were relatively uniform in concentration. *C. carassius* showed high variation in its ash content and this study reviewed it as the species with the lowest ash content. Moisture, ash and protein contents in *S. nigrita* were observed to be relatively high, while the high moisture and fibre content in *H. lineatus* was accompanied by low carbohydrate content. All the parameters analysed, in

the six fish species, protein had the highest concentration followed by fat, moisture, carbohydrate, ash and fibre respectively and mostly greater than what obtained in soyabean meal. The results from the present study are in agreement with previous workers (Grigorakis et al 2002, Nanna et al 2003; Gjederem 2004, Lisette 2005 and Karena et al 2006;).

TABLE 4: Review of Scientific names and chemical composition of six species fishes of the Wouri river coast in Douala, Cameroon

Proximate Composition(%):	Belt (TL)	Herring (CH)	Catfish (AM)	Disc (SD)	Redcarp (CC)	Mullet (SA)
Moisture	75.88±0.55	78.97±0.32	76.48±0.26	81.18±0.12	74.19±0.91	78.91±0.54
Protein	67.55±0.42	69.43±0.72	64.24±0.14	72.62±0.42	69.02±0.11	68.94±0.19
Fat	20.89±1.05	10.20±1.12	23.02±0.88	11.35±0.96	15.32±2.79	8.90±0.56
Ash	10.65±0.13	19.42±0.09	10.98±0.31	15.49±1.87	14.28±0.12	19.00±0.13

TL= (*Trichius lepturus*), CH= (*Clupea harengus*), AM= (*Arius maculatus*), SD= (*Symphysadon discus*), CC= (*Cyprinus carpio*), SA= (*Semotilus astromaculatus*), **Source:** Tenyang1, 2014.

Tenyang et al., 2014. (Table 4) reported in their study that the water content of these fish varied from one species to another and ranged these from 74.19 to 81.18%. The higher water content was obtained from the Disc sample (Symphysadon Discus) (81.18±0.12%), followed by Herring (Clupea Harengus) (78.97±0.32%), Mullet (Semotilus Atromaculatus) (78.91±0.54%). The lower water content was obtained from Red carp (Cyprinus Carpio) (74.19±0.91%). The high water content of the Disc predisposed it the more to degradation reaction such as hydrolysis. The total lipid content of the different fish species varied from one sample to another. They are generally high ranging from 8.90% to 23.02%. The highest fat content was obtained from the Catfish species (Arius Maculatus) (23.02±0.88% on dry matter) and the lowest fat content was obtained from the Mullet species (Semotilus atromaculatus) (8.90±0.56% on dry matter). Based on this classification, fish species such as Herring (Clupea harengus), Belt (Trichius lepterus), Catfish (Arius maculatus), Red carp (Cyprinus Carpio) and Disc (Discus symphysadon) are fatty fish and Mullet (Semotilus Atromaculatus) is a medium fat fish. The considerable variation in the total fat contents of the fish muscles among the species is due to both the importance of fish muscle as a storage site and its ability to deposit fat, but also in the food of these species in their natural environment, the season, age or even maturity of the species. The crude protein content of these samples of fish in their investigation varied from one fish to another. Catfish (Arius maculatus) had the lowest protein content (64.24±0.14) while Disc (Discus symphysadon) obtained the highest value of protein content (72.62±0.42). The protein content of the Herring (Clupea harengus) is higher than that obtained (14.5±0.1) by Sathivel Subramanian et al. (2014). In their investigation however, crude

proteins were much higher than the protein levels for Carp (16% wet weight; FAO, (2008). and Tilapia (5055% dry muscle tissue; (Onyeike et al. 2000). Some of the fish, especially marine fish are sources of higher polyunsaturated fatty acids quality and are much more susceptible to alteration reactions during transformation. Knowledge of chemical composition of these fish can predict reactions that can occur in these samples during treatment. The ash content for the different species of fish from the Wouri river coast varied from one species to another. It remained higher in Herring (Clupea harengus) (19.42±0.09) and lowest in the Belt (Trichius Lepterus) (10.65±0.13). The ash content of the Herring is higher than that found by Sathivel Subramaniam et al. (2014) (3.0±0.2). The high ash content of Herring and Mullet samples proves that these samples are much richer in minerals. The considerable variation of moisture, ash, crude protein and total lipids content of six studied species of fish from the Wouri river coast presented in Table 4 were in line with the findings of other authors (K. Azam, 2004).

Based on this study, all the fish species examined belonged to a high-protein (15-20%) category. They are, therefore, highly recommended as a good protein source more preferable to other sources of protein.

Table 5. Composition of Essential Amino Acids in Fishmeal and Soya bean Meal.

EAA, g/100g CP.	(FM 1)	(FM 2)	(SBM 1)	(SBM 2)
Arginine	5.7	4.66	7.33	4.01
Histidine*	2.41	2.03	2.69	1.49
Isoleucine*	4.74	3.02	4.55	2.47
Leucine*	7.74	6.95	7.71	4.24
Lysine*	7.91	7.21	6.36	3.92
Methionine*	3.02	2.52	1.41	0.85
Cysteine*	0.94	0.86	1.56	1.35
Phenylalanine*	4.12	3.12	5.03	2.79
Tyrosine*	3.33	1.55	3.83	1.9
Threonine*	4.37	3.21	3.89	2.19
Tryptophan*	1.18	Nd	1.37	0.8
Valine*	5.43	4.15	4.78	2.59
Aspartic acid	Nd	8.06	Nd	5.77
Serine	Nd	3.1	Nd	3.48
Proline	Nd	2.86	Nd	2.8
Alanine	Nd	5.2	Nd	2.51
Glutamic acid	Nd	11.22	Nd	10.19

Glycine	Nd	4.18	Nd	2.98

FM 1= Fishmeal 1, **Source:** Wanda et al., (2021).
FM 2= Fishmeal 2, **Source:** Shaban A. et al, (2021).
SBM 1= Soya bean meal 1. **Source:** Batal and Dale, (2010). **SBM 2**= Soya bean meal 2. **Source:** Constanza et al, (2011).
Nd= not detected.
* = Essential Amino acid.

The amino acid profile of FM makes feed ingredient as attractive as a protein supplement. (Table 5). Proteins in cereal grains and other plants (i.e, Soya bean) concentrates do not contain complete amino acids profiles and are usually deficient in essential amino acids like lysine and methionine. Crude protein and essential amino acids (EAA) composition of fish meal (FM 1) rendered Soya bean meal (SBM 1 and SBM 2)* respectively. The presence of essential amino acids was confirmed except for tryptophan in FM 2, Aspartic acid, serine, proline, Alanine, Glutamic acid and Glycine in both FM 1 and SBM 1 respectively. their absent, however, may be due to their decomposition as a result of the acid hydrolysis of the sample occurring during its preparation for amino acid determination, Wanda et al., (2021).

From Table 5, it could be noticed that the protein in crayfish meal had high biological value in diets for animals; it'is rich in essential amino acids (EAA) particularly lysine, valine and sulfur amino acids while, the high values of non-essential amino acids (NEAA) were found in glutamic acid and aspartic acid. Therefore, the presence of crayfish meal in a complete diet of the Animals will supplement any deficiencies of the aminoacids in vegetable proteins. El-Sherif et al., (2001).

Effects of replacing Soya bean meal with Fish meal in the diets of Broiler Chicken

The result of the study (Table 6) described the comparison of feed intake, final weight gain, dressing percentage, feed conversion ratio and carcass weight with fishmeal and soya bean meal respectively. The feed intake in fishmeal (F1) was significantly better than in soya beans (S1, S2, and S3). Feed conversion ratio being improved in fishmeal at 2.2 to 2.7 as in soya bean meal (2.3 to 2.5).

The results on feed consumption, weight gain, feed conversion ratio, and dressing percentage are given in table 6. significant differences were observed in the average feed consumption of birds on various experimental rations. However, there have been significant differences in the weight gain of birds fed on fishmeal as compared to soya bean meal.

The values obtained for feed conversion ratio (FCR) indicated in fishmeal showed slightly better values as compared to those on soya bean meal. The results on dressing percentage of birds also showed similar trends

and significantly better dressing percentages were obtained for birds given fish meal ration. The results on average final weight gain, feed conversion ratio, dressing percentage and carcass yield correlate well with each other in soya bean meal but lower than in fishmeal diets.

However, the lowest value of feed intake (0.7kg) was found in broiler chicks fed soya bean diet (S3) while the highest value (3.9) was found in fishmeal diet (F1). The highest final weight gain (2.5) was observed on fishmeal diet (F1) which differ from the value of 1.2 to 1.5kg in birds fed soya bean meal (S1-S3) the lowest value of 1.2kg was obtained on Soya bean diet (S1). The feed conversion ratio and feed efficiency followed the same trend with best values on diets F3 and S1 (2.5) and were reported to be significant ($p<0.05$). The daily feed intake of Soya bean diet ranged from 0.7 to 3.8kg and the difference between the values were affected either by the different processing methods. The overall performance of broilers fed differently processed soya bean meal showed that Carcass weight had lower values (1.0, 1.1kg and 1.2kg)) and better values in fishmeal (1.3,1.5 and 1.6kg). This can be attributed to toxic metabolites in raw soya bean accompanied by other complications in the gastrointestinal tract such as absorption and erosion of the microvillus in small intestine (Liener, 1994; Anderson Hafermann et al., 1992).

The average parameters of feed intake, final weight gain, dressing percentage, feed conversion ratio and carcass weight in fishmeal was 3.43, 1.86, 72.40%, 2.46 and 1.46. while the average parameters in Soya bean meal was 2.53, 1.46, 71.13%, 2.36 and 1.10 respectively. The result here showed that the average performance of broilers fed diet with fish meal was better than that of soya bean meal.

Feed Intake (Kg)	3.9	2.8	3.6	3.1	3.8	0.7
Final Weight Gain (Kg)	2.5	1.6	1.5	1.2	1.7	1.5
Dressing Percentage (%)	70.5	73.9	72.8	71.3	70	72.1
Feed Conversion Ratio (Kg)	2.2	2.7	2.5	2.5	2.3	2.3
Carcass Weight (kg)	1.5	1.6	1.3	1	1.1	1.2

Table 6: Effects of replacing Soya bean meal with Fish meal in the diets of Broiler Chicken

	FISHMEAL			SOYA BEAN MEAL		
Parameter	F1	F2	F3	S1	S2	S3

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Fish meal is consistently better nutritionally than soya bean meal, but far more expensive , soya bean meal on the other hand , though inferior to fish meal is still a good source of protein in poultry diets, but cheaper than soyabeans

4.2 Recommendations

1 Fish meal is recommended in the feeding of broiler chicken, for farmers that can afford it

11 Farmers are adviced to make appropriate choice of fish to formulate Animal feed based on their nutritional requirement, particularly Monogastric Nutrition, (i.e in Poultry).

REFERENCES

Abbey TK, Alhassan A, Ameyibor K, Essiah JW, Fometu E, and Wiredu MB, (2001). *Integrated Science for Senior Secondary Schools*. Journal of Unimax Maxmillan Ltd., Accra North. Ghana. 2001; Vol. 1 Pg – 451

Adugna (2020). *Effects of fish by-products meal inclusion in broiler feeds on growth performance.* Journal of experimental Agriculture international. Vol. 42 (7) Pg 76-81 Article JEAL 57851

Alemayehu, Y. M. Urge, and A. Getu (2015). *Effects of levels of inclusion of locally processed fish waste meal in the diets of white leghorn layers on performance parameters, hatchability, economics, egg production and egg quality*. Iran. J. Appl. Anim. Sci. vol. 5: Pg- 689–698.

Ali et al., (1993). *Comparative performance of broiler chickens on commercial and corn-soya bean meal based rations.* Animalnutrition program. Animal science institute NARC Pakistan. Vol. 6 (no 1) Pg 115-122

Amino Dat (2016*).* *Nutrition and care GmbH, Animal Nutrition, Hanau, Evonik Industries*. Essen, Germany. Open journal of Animal Science, Vol. 6 No. 3 Pg – 9-11

Anderson Hafermann, J. C., Zhong, T., & Parsons, S. (1992). *Effect of heating on nutritional quality of conventional and kunitz trypsin inhibitor-free soy beans.* Poultry Science, 71, 1700-1709

AOAC (Association of Official Analytical Chemists), (1999). *Official Methods of Analysis AOAC International Methods* 934.01, 988.05, 920.39, and 942.05. Arlington, VA. USA: AOAC International.

Banaszkiewicz, T. (2000). *Nutritive Value of New Rape Cultivars Stated in the Tests for Broiler Chickens (in Polish).* Thesis University of Podlasie, Vl. 61: Pg. 1-99.

Batal and Dale, (2010). *Utilization of plant proteins in fish diets: effects of global demand and supplies of fishmeal.* Journal of Animal physiology and Animal Nutrition. Volume 95, issue Vol. 6, Pg. 685692.

Bayero A.S, Datti Y, Abdulhadi M., Yahaya A.T., Salihu L., Lado U. A., Nura T., and Imrana B., (2019). Proximate composition and minerals contents of Soya beans (Glycine max) available in Kano state, Nigeria. *Chemsearch Journal 10*(2). Pg – 62-65

Benerjee G. C (1986).*Poultry*. 2nd ed. Mohan primlani for oxford and Pub Comp 66 janapath, New Delhi 110001

Bernard et al., (2022). *Nutritional composition and heavy metal contamination of prominent fishmeal samples*. Journal of fisheries and Aqua Science. Vol. 17 (1) 2022. Pg. 1-8

Boydak, E.; Alpaslan, M.; Hayta, M.; Gerçek, S.; Simsek, M. (2002*). Seed composition of soybeans grown in the Harran Region of Turkey as affected by row spacing and irrigation*. Journal of Agricultural and Food Chemistry, v.50, Pp.4718-4720,

765

Constanza Soledad Carrera, Cora Marcela Reynoso, Gustavo Javier Funes, María José Martínez, Julio Dardanelli and Silvia Liliana Resnik, (2011). *Amino acid composition of soybean seeds as affected by climatic variable.* Pesq. agropec. bras., Brasília, Vol.46, n.12, Pg.1579-1587, dez. 2011

Centre of Excellence Science Seafood Health (2011). *Sea food, nutrition and human health. A synopsis of the nutritional benefits of consuming seafood.* Chemists Washington DC vol. 4, Pg: 1-5.

Chukwu O. (2009). *Influences of drying methods on the nutritional properties of tilapia fish*. World Journal of Agricultural Science Vol. 5: Pg. 256-258.

C. Ndome, O. Oriakpono and A. Ogar, (2010). *Proximate composition and Nutritional values of some commonly consumed fishes from the Cross River estuary.* Research gate. Vol. 19 (1) Pp- 11-18

De Conto LC., Gragnani MAL., Maus D., Ambiel HCI., Chiu MC., Grimaldi R. and Goncalves LAG. (2011). *Characterization of Crude 62 Watermelon Seed Oil by Two Different Extraction Methods*. Journal of American Oil Chemists' Society Vol. 88: Pg- 1709 - 1714.

Effiong BN and Fakunle JO. (2011). *Proximate and mineral composition of some commercially important fish in Lake kainji, Nigeria.* Journal of Basic Applied Science Resources. Vol. 5: Pg. 2497-2500.

El-Sherif, S. A. (2001). Chemical and technological studied on shrimp and its wastes. Ph. D. Thesis, Fac., of Agric., Fayoum, Cairo Univ., Egypt. Pg. 56-58

Eshun G, (2012). *Nutrient composition and functional properties of bean flours of three soya bean varieties from Ghana*. African Journal of Food Science and Technology. 2012; vol. 3(8): Pg. 176-181. ISSN: 2141-5455

E.N. Onyieke E.O, Ayoologu C.O. and Ibegbulam, (2000). *Evaluation of the nutritional value of dome crude oil in polluted freshwater fishes. Global Journal of Pure and Applied Sciences* Vol. 6, Pg-227-233.

FAO, (2008). FAO *Fisheries* *and Aquaculture-Chemical elements of fish*. Hyyp://www.fao.org/fishery/ topics/14820

FAO/WHO/UNU, (1985). *Energy and protein requirements* (WHO Tech. Report Series No. 724). WHO, Geneva, Switzerland

Food Labeling (1999) *Health Claim Soy Protein and Coronary Heart Disease*. Final Rule. Pp3 – 14.

Gabriel AF., Igwemmar N C., Sadam AA. and Babalola SA. (2018*) Characterization of Seed Oil From Citrullus lanatus (Watermelon) Direct Res.* J. Public Health and Environ. Technol. Vol. 3(2): Pg. 34-40.

Gjederem T. (2004). *Genetic improvement of cold water fish species*. J. Aquaculture Research, Vol. 31; Pg. 25-33.

Grieshop, C.M. and Fahey, G.C., Jr. (2001) *Comparison of Quality Characteristics of Soybeans from Brazil, China, and the United States*. Journal of Agriculture and Food Chemistry, Vol. 49: Pg. 2669-2673.

Grigorakis, K., Alexis, M.N., Taylor, K.D.A.and Hole, M. (2002). *Comparison of wild and cultured gilthead sea bream (Sparus aurata)*: composition, appearance and seasonal variations. International Journal of Food Science and Technology, Vol. 37 (5), Pg. 477-484.

Hassan et al., (2007). *Determination of Chemical Composition, Mineral Contents, and Protein Quality of Iranian Kilka Fish Meal.* International Journal of Poultry Science Vol. 6 (5): Pg354-361, 2007

Herger et al., (2016). *Impacts of different processing of full fat soya bean on broiler performance.* Czech Journal of Animal Science. Vol. 61, 2016 (2); Pg 57-66

International Institute of Tropical Agriculture (IITA) (1990). *Soya Bean for Good Health: How to Grow and Use Soybeans in Nigeria*. IITA Publications. 23.

Islam et al., (1991). *Complete replacement of dietary fishmeal by duckweed and soya bean meal on the performance of broilers.* Department of Animal nutrition,Bangaladesh Agriculture University. Vol. 10 (no. 6) Pg 629-634

Jacob, J. (2013). *Feeding fishmeal to organic poultry. eOrganic.* Accessed Jul. 2017. http:// articles.extension.org/pages/70046/including-*fishmealin-organic-poultry-diets.*

Jacquie J, (2000). ***New*** *Technologies for Agriculture Extension grant no*. 2020- Pg. 41595-30123 from the USDA National Institute of Food and Agriculture.

Karena A., Michael, J., and Maria, J. G. (2006). *Detritivores and the stoichiometry of nutrient cycling by a dominant fish species in lakes of varying productivity.* Journal of Wiley inter science. Vol. 2. Pg. 2428

Kumar, v.; rani, a.; solanki, s.; hussain, s.m. (2006). Influence of growing environment on the biochemical composition and physical characteristics of soybean seed. Journal of Food Composition and Analysis, Vol.19, Pg.188-195,

K. Azam, M.Y. Ali, (2004) *Biochemical Assessment of selected fresh fish*. Journal of Biological Sciences 4, Pg. 9-10

Liener, I. E. (1994). *Implication of anti-nutritional component sin soy bean foods*. Critical Review of Food Science and Nutrition, 34, 31-67.

Lisette, E.T. (2005). *Variation among fish species in the stoichiometry of nutrient excretion*. M.Sc. Thesis University of Miami, oxford, Ohio. Pg. 43

Lokuruka MNI (2010) *Soybean Nutritional Properties: The Good and the Bad About Soy Foods Consumption*-A Review African Journal of Food Agriculture Nutrition and Development Vol. 10 (4): Pg. 2439-2459

Maidala et al., (2019). *Growth performance and economics of broiler chickens' production fed full fat soy bean as affected by different processing.* Journal of Animal Science and Veterinary medicine Vol. 4 (1) Pg 34-40

Mavromichalis, I.2018. *Fish meal in poultry diets: To use, or not to use?* WattAgNet, Jan. 29, 2018; Accessed Jun. 2018. https://www.wattagnet.com/articles/33296-fish-meal -in-poultry-diets-to-use-or-not-touse. Pg. 113-120

Mcmanus A, and Newton W. (2011). *Seafood, nutrition, and health: A synopsis of the nutritional benefits of consuming seafood*. Center for excellent seafood and health. Curtin Health Innovation Research Institute, Curtin University of Technology, Perth Australia.Vol. (5) Pg 1-8.

Miller D (1970). *Mineral mixture compositions- A factor in chick bioassays of the protein quality of fishmeal*. Poultry Science Vol. 49. Pg 1535-1540

Miles, R. D., and J. P. Jacob. (2011). *Fishmeal: Understanding Why This Feed Ingredient is So Valuable in Poultry Diets*. University of Florida Cooperative and Extension Service. Accessed Sept. 2017. http://ufdcimages.uflib.ufl.edu/IR/00/00/42/64/00001/ PS04300.pdf.

Nanna, R., Mohammed M. & Shakintala, H. (2003). *Small fish species in Bangladesh contribution to vitamin A, calcium and iron intake.* Journal of Amer. Soc. Nutri. Sci. Vol. 133, Pg. 40215-40265.

Nargis A. (2006). *Seasonal variation in the chemical composition of body flesh of koi fish Anabas testudineus (Bloch) (Anabantidae*: Percifomes). Bangladesh J. Sci. Ind. Res. Vol. 41(3-4), Pg. 219226

National Research Council, 2021. *Nutrient Requirements of Poultry*. National Academy Press, Washington, DC. Supported by Eupean federation of Animal Science. 9th rev. ed.

Ndelekwute et al., (2016). *Effect of fishmeal and blood meal on growth, carcass yield, internal organs size and economics of broiler chickens.* Journal of Animal production research. Vol. 28 (1) Pg 151-159

N. Tenyank. H.M. Womeni1* M. Linder2 B. Tiencheu1 P. Villeneuve3 F. Tchouanguep Mbiapo1 (2014). *The chemical composition, fatty acid, amino acid profiles and mineral content of six fish species commercialized on the Wouri river coast in Cameroon*. La rivista itaLiana deLLe sostanze grasse grasse - voL. XCi - aPriLe/giUgno 2014

Ochetim S. (1991). *Performance of broilers and layers fed locally produced fish waste meal in western Samoa.* School of Agriculture, University of South Pacific Alafua campus, Apia western Samoa. Vol 2 (1) Pg 24-25

Ogbemudia RE., Nnadozie BC. and Anuge B. (2017) *Mineral and Proximate Composition of Soya Bean Asian Journal of Physical and Chemical Sciences* Vol. 4(3) Pg. 1-6

Osibona, A. O., Kusemiju, K. & Akande, G. R. (2009). *Fatty Acid Composition and Amino Acid Profile of the African Catfish* (Clarias gariepinus). acta SATECH , Vol.3(1), Pg. 85 – 89

Pike, I. H. (2017). *The role of fishmeal in diets of poultry*. Int. Assoc. Fish Meal Manufact. Tech. Bull. 3: 1–40. Accessed Sep. 2017.

mo, G., Lasuncion, M.A. and Anroyo, G. (2002) *Response of Rats to the Intake of Tofu Treated Under High Pressure*. Innovative food science and emerging technologies Vol (3): Pg. 149-155.

Shaban A. El-Sherif, Mahamed Abou-Taleb, Sayed M. Ibrahim, Abdelrahman S. Talab* and Safwat Abd El-Ghafour, (2021). *Nutritional composition and amino acid profile of the crayfish byproduct meal*. Egyptian Journal of Aquatic Biology & Fisheries Zoology Department, Faculty of Science, Ain Shams University, Cairo, Egypt. ISSN 1110 – 6131 Vol. 25(4): Pg. 909 – 915 (2021)

S. Sathivel, P.J. Bechtel, J. Babbitt, W. Prinyawiwatkul L. and Loan, K.D. (2004). *Respond, Properties of protein powder from Arrowtooth Flounder (Atheresthes stomias) and Herring (Clupea harengus) Byproducts*. J. Agric. Food Chem. Vol. 52, Pg. 5040-5046,

Sirtori, CR, Lovatti, MR. (2001) Soy proteins and cardiovascular disease. Corr. Atheroscler. Vol;3: Pg 47-53 Wanda Kudełka, Małgorzata Kowalska, and Marzena Popis, (2021*). Quality of Soybean Products in Terms of Essential Amino Acids Composition*. Molecules 2021 Pg. 50-71. https://doi.org/10.3390/molecules26165071 .

Sushree et al., (2017). *Effect of dietary incorporation of fish silage on growth performance, serum biochemical parameters and carcass characteristics of broiler chickens.* Indian Journal of Animal Research. Vol 5 (3) Pg 36-39

Waldroup, P.W., P.V. Walleghem, J.L. Fry, C. Chicco and R.H. Harms, 1965. *Fish meal studies. 1. Effects of levels and sources on broiler growth rate and feed efficiency*. Poult. Sci., Vol. 44: Pg 10121016.

Waldroup, P.W. and M.H. Adams, 1994. *Evaluation of the phosphorus provided by animal proteins in the diet for broiler chickens.* J. Appl. Poult. Res., Vol. 3: Pg 209-218.

Wilson, R. Seed composition. In: Stewart, B.a. And Nielsen, D.r. (Ed.). (2004). *Soybeans: improvement, production and uses*. 3rd ed. Madison: ASA/CSSA/SSSA, Pg.621-677. (Agronomy monograph, 16).