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Nutrition value of dominant three fishes of Sudanese red sea coast

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Abstract
Based on the current demand on fish as food, marine fishes of the Sudan have been arbitrary divided into first, second and third grade fish. Examples of these are the red emperor (*Plectroponus moculates*) grade I, mullet fish (*Plectroponus moculates*) as grade II and unicorn fish (*Naso unicornis*) as grade III. This subjective grading, need to be evaluated on grounds of organo-leptic tests, gross chemical and body parts analysis and inclusion in experimentally designed feeding tests. The mean value and range of moisture, protein, fat and ash was determined and compared for the three species. The highest calorific value was (232.08) in *C. crisbis* and the lowest (144.2) in P*. maculatus.* The calorific value was expressed as a calories per percent of protein content plus calories per percent of fat content. The highest calorific value was (232.08) in *C. crisbis* and the lowest (144.2) in P*. maculatus.* The gross chemical composition was comparable between the three groups in ash content, but showed significant variability within moisture, within protein and in fat. The mean body weight in each cell in a column (feed1, 2, 3 and the control) was based on a triplicate and they were compared using the least significant difference (LSD) test. Very highly significant growth correlation (p<s0.001) was found in chicks group fed control feed. The calculated r=0.972 was higher than the tabulated r=0.924. Feed 1, feed 2 and Feed 3 showed significant growth correlation (p<0.05). The calculated r-value ranged from 0.796 to 0.832 and the tabulated (r=0.707). The preference of the three fish species by gender, ranked *P. maculate* as grade I, *C. crenilabis* as grade II and *N. unicornis* as grade III. The % preference was in agreement between both genders.

Keywords: *Plectroponus moculates*, *Plectroponus moculates*, *Naso unicornis*, moisture, protein, calorific value

1. Introduction
Fish as food is an important commodity because of is content of proteins and essential amino acids needed for healthy growth and maintenance of the body (Washington, 2005) [2]. In addition, fish has an acceptable taste, can be prepared as meal in a variety of ways and it is affordable. The fish fatty acids are saturated containing omega 3 that helps in melting the cholesterol (Artemis, 2008) [3]. Fish contain many minerals and vitamins that have an important role for building the body (FAO, 2002) [11].
Ahmed (1987) [1] product made from trash fish, the bones and remains of processed fish, unwanted fish species and undesirable size (Ahmed, 1987) [1]. Fish meal is made in form of stated that fish species differs in their body chemical constitutes according to their food, feeding habits, season and living grounds of the species. Fish meal, is a commercial powder or cake obtained by drying the fish and /or its trimming during filleting after well mincing and through mixing. Fishmeal is a nutrient-rich and high protein supplement feed ingredient that stores well and is used primarily in diets for domestic animals and sometimes as a high quality organic fertilizer (Naylor *et al*., 2000) [18].
Bone and Moore (2008) [7] divided fish according to their food habits into three main groups by:
1- Herbivorous fish like *Naso* spp., and goatfish that feeds on see grass and seaweeds.
2- Carnivorous fish such as sharks and groupers which eat fish and other organisms.
3- Omnivorous fish such as *Mugil* spp., which feed on phytoplankton and protozoa found in water.

Based on the current demand on fish as food, marine fishes of the Sudan have been arbitrary divided into first, second and third grade fish. Examples of these are the red emperor (*Plectroponus moculates*) grade I, mullet fish (*Plectroponus moculates*), as grade II and unicorn fish (*Naso unicornis)* as grade III. This subjective grading, need to be evaluated on grounds of organoleptic tests, gross chemical and body parts analysis and inclusion in experimentally designed feeding tests.

2. Objectives

The objective of this work on *P. maculate C. crenilabis* and *N. unicorns* are to study

1. Chemical composition.
2. Fish meal as a food source for poultry.
3. Consumer grading of the studies fish through a constructed questionnaire.

3. Material and methods

2.1. Gross chemical composition

The gross chemical composition was determined according to the standard method of the Association of Official Analytical Chemists (AOAC, 2003).

2.2. Moisture content

The moisture content in a weighed sample is removed by drying the sample in an electric oven (Kat-NR.2851, Elektrohelios, Sweden) at 105±1ºC. The difference in weight before and after drying is calculated as a percentage from the initial weight.

$$\text{Moisture content \%} = [W_1 - W_2] \times 100 \div W_1$$

Where
W_1= Original weight of sample.
W_2= Weight of sample after drying.

2.3. Protein content

The crude protein content was determined by a micro-Kjeldahl digestion unit (Tecator, Sweden) based on oxidation and conversion of nitrogen to ammonia, which reacts with sulphuric acid forming ammonium sulphate. The solution is made alkaline with and the ammonia is distilled into 2%Boric acid to form the ammonia-boric acid complex. The complex is titrated against a standard solution of Hcl (0.1N). The crude protein content is calculated by multiplying the total N% by 6.25 as a conversion factor for nitrogen to protein.
The following formula was used:

$$N\% = [\text{Vol.g Hcl} \times 6.25 \times 14] \div \text{weight of sample} \times 1000$$

Where
N% = crude nitrogen.
N = normality of Hcl.
14 = equivalent weight of nitrogen.

2.4. Fat content

A sample of 5±1g was of dry fish meat weighed into an extraction thimble and covered with wool cotton that was previously extracted with petroleum ether. The sample and a pre-dried and weighed Erlenmeyer flask containing 100 ml petroleum ether (No 1622, BDH, England) were attached to the extraction unit (Electro thermal, England) and the temperature was adjusted to produce about 150 to 200 drops of the condensed solvent per minute for 16 hours. At the end of the distillation period, the flask was disconnected from the unit and the solvent was redistilled. Later, the flask with the remaining crude ether extract was heated in a water path for 3 hours, cooled to room temperature in a desiccator, reweighed and the dried extract was registered as crude fat according to the following formula:

$$\text{Fat\%} = [W_2 - W_1] \times 100 \div W$$

Where
W_1 = weight of empty flask.
W_2 = weight of flask with oil.
W = weight of sample in g.

2.5. Ash content

A 5±1g dry fish muscle sample was well ground and weighed into a pre-heated, cooled weighed porcelain crucible. Before ashing, the sample was pre-washed on an electrical pre-asher and placed into a muffle furnace (Carbolite, Sheffeild, England) at 525 to 600ºC for six hours. After complete ashing the crucible with ash were transferred directly to a desiccator, cooled, weighed and ash is calculated as percent of original weight of sample:

$$\text{Ash content \%} = [W_1 - W_2] \times 100 \div W$$

Where
W_1 = Weight of crucible with ash in g.
W_2 = Weight of empty crucible in g.
W = Sample weight in g.

2.6. Nutritive Value

Calculations of digestibility and caloric value followed Babiker (1981) [27].
1- Digestibility
This is a based on Fat: protein value
2- Caloric value
This were based on the equation
Caloric value = protein×4.1+ Fat ×9.5.
The results of the study of fish samples of *P. maculats, C. crisbis* and *N. unicoris* were given below.

4. Poultry chicks feeding experiment

The experiment was conducted in a private `farm in Salum, (37º7'E, 19º2*1*'N) 26Km west of Port Sudan town. The farm adopted the closed system in which the temperature was controlled by using fans and air conditioners. Vaccination and immunization followed the standard protocol (Table. 1). The cages were cleaned according to the standard procedures.
The present study aimed to evaluate the impact of fishmeal on chick growth. A completely randomized design with 10 treatments and three replicates of five birds each was used. The experiment lasted for 45 days.
The assessment of the nutritive value of each fish species was determined based on feeding experiments on 1- day old chicks till they reach 45 days old, according to the following protocol:
The number of groups is 10, one control and 9 experimental.
The number of replicates is 3.
The number of chicks in each group is 5.
Their food ratio was used. There were 2 fish powder: 1 flour; 1 fish powder: 1flour; and fish powder: 2flour.
The food ratio was calculated and adjusted every 4 days.

The weight of each chick was recorded daily for up to day 45. Feeding ratio for each chick in mg/day was adjusted as follows: 1st week 50-70g; 2nd week 71-85; 3rd week 86-100g; 4thweek 101-110g and 5thweek 111-150g.

Table 1: Standard vaccination protocol

Day	Vaccines
1-5	Antibiotic, anti-Salmonella, neomycin and vitamin complex
7	Newcastle plus
12	(IBD) Gambaro
15	Penicillin
17	Anti-coccidian and vitamin complex

5. Questionnaire

A questionnaire was randomly distributed to generate data from costumer and workers in the fish market regarding the selected three species. The questions included demographic data, species preference, purchasing attitude and fish meal preparation (Appendix 1)

6. Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) as appropriated.

One-way analysis of variance (ANOVA) was used to compare the means of measurements of the three fish species. ANOVA was also applied to compare the growth modes resulting from Feed 1, Feed 2, Feed 3 and the Control.

The Least Significant Difference (LSD) was used to assess the significance of differences within and between fish species and also for the different feeds.

Simple regression analysis was used to quantify the correlation between different traits.

Descriptive statistic was used for the questionnaire data.

A probability of ($p<0.05$) was considered to be statistically significant.

7. Results

3.1 Chemical composition

The mean value and range of moisture, protein, fat and ash was determined and compared for the three species Table 1 and Fig. 1. The table also included digestibility indicator (Fat: Protein ratio) and a nutritive indicator (calorific value). The table revealed that:

1. The order of mean moisture content was ***P. maculatus*** *>**N. unicorns*> *C. crisbis*. The minimum mean moisture content was 60.78 and the maximum was 68.60%.
2. The order of mean protein content was ***P. maculatus***> *C. crisbis*>***N. unicorns***. The minimum mean protein content was 22.28 and the maximum was 26.14%.
3. The order of mean fat content was *C. crisbis*>***N. unicorns***> ***P. maculatus***. The minimum mean fat content was 3.89 and the maximum was 14.18%.
4. The order of mean ash content was *N. unicorns*> ***P. maculatus*** *= C. crisbis.* The minimum mean ash content was 1.35 and the maximum was 1.41%.
5. The fat to protein ratio showed that ***P. maculatus*** had the lowest value (0.170:1.0) and *N. unicorns* had the highest value (0.237:1.0).
6. The calorific value was expressed as a calories per percent of protein content plus calories per percent of fat content. The highest calorific value was (232.08) in *C. crisbis* and the lowest (144.2) in ***P. maculatus***

Table 2: Mean and range (between brackets) of the gross chemical composition of *P. maculatus* (n=69), *C. crisbis* (n=60) and *N. unicorns* (n=55).

%	***Plectroponus moculates***	***C. crisbis***	***N. unicorns***
	Mean ±SD	Mean ±SD	Mean ±SD
Moisture	68.605±0.10 (67.01-70.2)	60.78±0.0421 (58.10-63.46)	65.675±0.045 (65.45-65.90)
Protein	26.14±0.29 (25.59-27.69)	23.75±0.181 (22.81-24.69)	22.28±0.118 (21.12-23.44)
Fat	3.89±0.12 (1.75-4.28)	14.18±0.01 (10.49-17.87)	10.635±0.125 (9.67-11.6)
Ash	1.35±0.10 (0.24-0.82)	1.35±0.101 (1.34-1.36)	1.41±0.219 (138-1.44)
Fat: Protein	0.170:1.0	0.186:1.0	0.237:1.0
Calorific Value	144.2	232.08	188.126
Kook ability index M-F	72.5	74.96	76.31

The gross chemical composition was comparable between the three groups in ash content, but showed significant variability within moisture, within protein and in fat (Fig. 11).

One-way analysis of variance (Table 10) showed extremely highly significant difference ($p<0.000$) in moisture, protein, fat and ash content within and between ***P. maculatus***, ***C. crisbis*** and ***N. Unicorns*** This is indicated by the calculated F-value which is extremely higher than the tabulated F-value at Degree of Freedom $_{3, 36}$ which equals 4.51 (Table 10).

Table 3: Analysis of Variance of chemical composition of ***P. maculatus***, ***C. crisbis*** and ***N. Unicorns***

Source of variation	SS	DF	MSS	F cal.	F tab.	Sig.
Plectroponus moculates						
Between groups	29443.518	3	9814.506	10610.28	4.51	0.000
Within Groups	33.289	36	0.925			
Total	29476807	39				
Plectroponus moculates						
Between groups	14174.712	3	4724.904	9.623	4.51	0.000
Within Groups	17675.751	36	490.993			

Total	31850.463	39				
Naso unicornis						
Between groups	24112.027	3	8037.343	1864.8`2	4.51	0.000
Within Groups	155.148	36	4.310			
Total	24267.175	39				

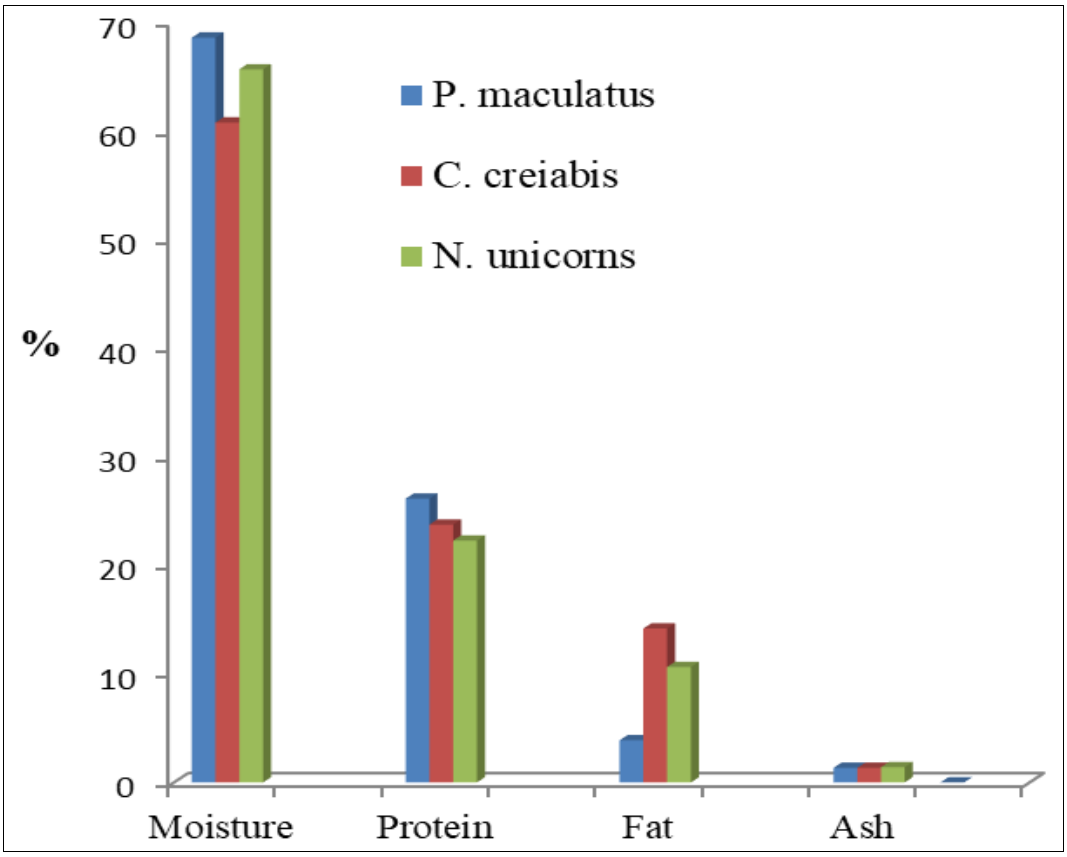

Fig 1: Chemical composition of *P. maculatus, C. crisbis, N. unicorns*

3.2. Growth experiment:

The following description of growth of chick feed from day 1 to day 41 was based on feed adjustment. Feed was adjusted every fifth day based on the average gain in chick body weight in each group.

The mean body weight in each cell in a column (feed1, 2, 3 and the control) was based on a triplicate and they were compared using the least significant difference (LSD) test.

1. In Table 11 means with different superscripts in a row are significantly different ($p>0.05$), while means in a column with different subscripts are significantly different ($p>0.05$).
2. There is no significant differences ($p>0.05$) between the body weight gain of chick by the end of day four. The superscripts attached to the mean were similar in chicks fed Feed 1, Feed 2, Feed 3 and the control (Table 11 and Fig, 12).
3. From day 5 to day 12, the three feeds showed progressive growth with no significant difference between them ($p>0.05$). The control showed highly significant difference ($p<0.001$) as compared with feeds 1, 2 and 3.
4. As from day 13 to day 36, the chicks showed progressive gain in body weight (Fig. 12) with different level of significance. However, the control group continued to show progressive significant body weight gains ($p<0.001$).
5. By the end of the feeding experiment at day 45, chicks received experimental feed1 or 2 or 3 gained body weight about 80% of chicks fed the control feed (Table 11 and Fig. 12).

Table 4: Weight of chicks (Mean ±SD) fed on Feed 1 (*P. maculatus*), Feed 2 (*C. crisbis*) and Feed 3 (*N. unicorns*).

Feeding from day	Feed 1	Feed 2	Feed 3	Control
1 to 4	32.25^{a}_{a} ±1.95	32.25^{a}_{a} ±1.95	32.33^{a}_{a} ±1.37	32.66^{a}_{a} ±1.96
5 to 8	77.16^{a}_{b} ±6.07	72.67^{a}_{b} ±3.22	70.42^{a}_{b} ±2.19	129.25^{b}_{b} ±9.21
9 to 12	99.4^{a}_{c} ±6.54	97.58^{a}_{c}±9.10	105.25^{a}_{c} ±7.08	365.00^{b}_{c}±29.09
13 to 16	165.25^{a}_{d}±18.51	150.17^{b}_{d}±21.47	149.25^{b}_{d}±15.01	555.58^{c}_{d}±34.25
17 to 20	377.83^{a}_{e}±34.22	281.17^{b}_{e}± 27.6	331.75^{c}_{e}±26.81	768.50^{d}_{e}±29.0
21 to 24	508.50^{a}_{f}±25.69	421.67^{b}_{f}±32.49	434.83^{b}_{f}±43.16	1006.3^{c}_{f}±9.40
25 to 28	$774.92^{a,b}_{g}$±38.81	$800.17^{b,c}_{g}$±11.82	832.33^{c}_{g}±93.23	1235.5^{d}_{g}±41.98
29 to 32	1196.8^{a}_{h}±61.41	1195.8^{a}_{h}±12.70	1111.9^{b}_{h}±88.79	1574.3^{c}_{h}±41.98
33 to 36	1467.4^{a}_{i}±47.94	1467.0^{a}_{i}±72.0	1412.2^{b}_{i}±20.80	1827.1^{c}_{i}±10.08
37 to 41	1768.1^{a}_{i}±39.84	1767.9^{a}_{i}±57.06	1761.1^{a}_{i}±69.69	2184.5^{b}j±129.9

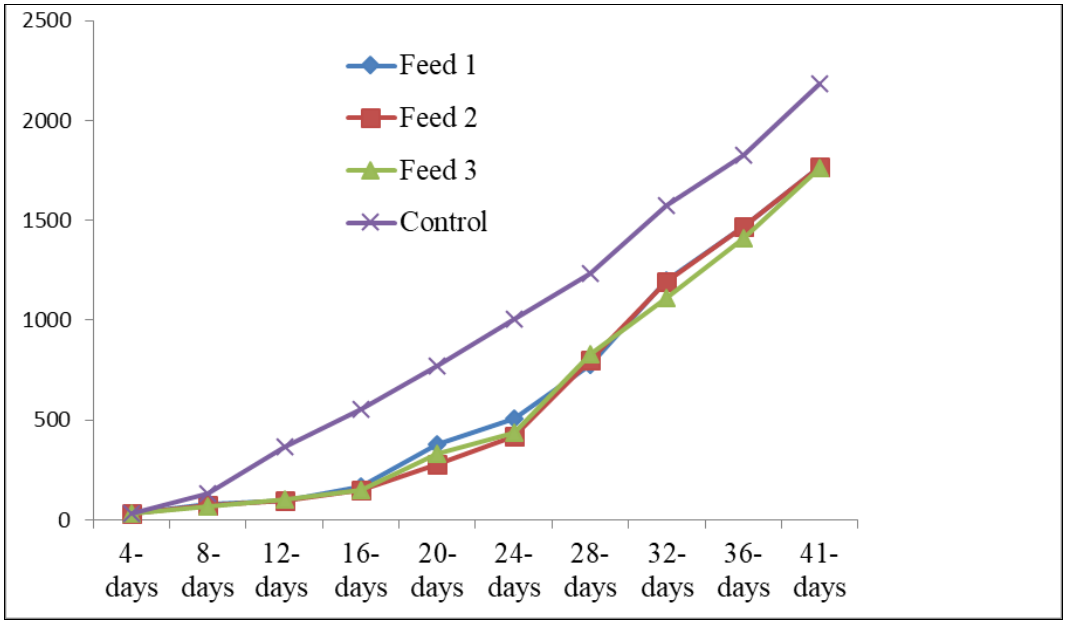

Fig 2: Growth rate during the feeding experiments

Simple regression analyses of changes in body weight of chick's receiving experimental and control diet with time showed that:

1. Very highly significant growth correlation ($p<0.001$) was found in chicks group fed control feed. The calculated r=0.972 was higher than the tabulated r=0.924.
2. Feed 1, feed 2 and Feed 3 showed significant growth correlation ($p<0.05$). The calculated r-value ranged from 0.796 to 0.832 and the tabulated (r=0.707) Table 12.

Table 5: The relationship between increase in body weight and days

Species	Regression equation	r Calc	r tab	p
Plectroponus moculates	Y=199.7X-446.6	0.832	0.707	p<0.05
Plectroponus moculates	Y=199.7X-470.1	0.796	0.707	p<0.05
Naso unicornis	Y=194.7X-447	0.813	0.707	p<0.05
Control	Y=239.8X-351	0.972	0.924	p<0.001

3.3 Questionnaire results

The questionnaire (appendix I) was designed to generate information about the grading of *P. maculate*, *C. crenilabis* and *N. unicornis* and to find out whether it is inconformity with that of the Fisheries Administration grading or not? The numbers of persons subject to the questionnaire were 187 and they were randomly selected. The questionnaire results were subjected to descriptive statistical analysis.

The preference of the three fish species by gender, ranked *P. maculate* as grade I, *C. crenilabis* as grade II and *N. unicornis* as grade III (Table 13). The % spreference was in agreement between both genders,

Table 6: Preference of *P. maculate*, *C. crenilabis* and *N. unicornis* by gender

Fish species	Males		Females	
	No.	%	No.	%
Plectroponus moculates	115	78	29	75
Plectroponus moculates	28	19	6	15
Naso unicornis	5	3	4	10

The different age groups preferred *P. maculate* to *C. crenilabis* and *N. unicornis* was the least preferred (Table 14). However, age group above 60 prefers C. *crenilabis* only.

Table 7: Preference of *P. maculate*, *C. crenilabis* and *N. unicornis* by age group

Fish species	Age group				Total
	< 20	20-39	40-59	>60	
P. maculatus	8 (5.71)	104 (74.3)	28 (20)	0 (0)	140 (100)
C. crenilabis	1 (2.63)	20 (52.63)	13 (34.21)	4 (10.62)	38 (100)
N. unicornis	0 (0)	7 (77.8)	2 (22.22)	0 (0)	9 (100)
Total	9	131	43	4	187(100)

All people subject to questionnaire irrespective of their job, preferred *P. maculate* to *C. crenilabis*, and *N. unicornis* was the least preferred (Table 15). However, a group of workers not enlisted in the questionnaire ranked *C. crenilabis* as grade I, *P. maculatus* as grade II and as *N. unicornis* grade III

Table 8: Preference of *P. maculate*, *C. crenilabis* and *N. unicornis* by job

Job	*P. maculatus*		*C. crenilabis*		*N. unicornis*		Total	
	No	%	No	%	No	%	No	%
Labours	7	63.63	2	18.18	2	18.18	11	100
Free business	32	78.04	7	17.07	2	4.87	41	100
Employee	70	81.39	13	15.11	3	3.48	86	100
Student	24	72.72	7	21.21	2	6.06	33	100
House wife	9	64.28	5	35.71	0	0	14	100
Other	2	100	0	0	0	0	2	100
Total	144		34		9		187	100

Irrespective of monthly income, the preference of fish was in the order of *P. maculatus*, *C. crenilabis* and *N. unicornis* (Table 8

Table 9: Consumer preference of *P. maculatus*, *C. crenilabis* and *N. unicornis* based on income

Monthly income	Fish preference (% given in brackets)			Total
	P. maculatus	*C. crenilabis*	*N. unicornis*	
Low	7, (4.9)	1, (2.9)	0, (0.0)	8, (100)
Medium	72, (50)	12, (35.3)	5, (55.6)	89, (100)
High	31, (21.5)	9, (26.5)	2, (22.2)	42, (100)
Very high	34, (23.6)	12, (35.3)	2, (22.2)	48, (100)
Total	144,(100)	34, (100)	9, (100)	187, (100)

8. Discussion

4.1. Chemical composition

Fish and fish products are assuming a substantial quantitative rise in the domestic and export markets due to the increasing awareness about healthy foods. In this context, fish is finding more acceptances because of its nutritional qualities (Nair, 2006) [17].

The knowledge of the body and chemical composition of fish is of fun damental importance in estimating the quality of the raw material, storage stability, and application of technological processes (Barua *et al*., 2012) [6]. The body composition of fish is basically composed of fillets, head, and skeleton elements and visceral. On the other hand, the chemical composition of fish is basically composed of moisture, protein, Fat, and ash (FAO, 2002) [11]. The first three constituents create the nutritional value, functional aspects, and sensory characteristics of the fish flesh. In addition, fish is an excellent source of high quality protein, rich in amino acids desirable by human beings (Ravindra and Pahwar, 2001) [20].

The mean value and range of moisture, protein, fat and ash was compared for the three species. The comparison revealed that the order of mean and range of moisture was *P. maculatus*>*N. unicorns*>*C.crisbis*; protein was *P. maculatus* >*C.crisbis* >*N. unicorns* and fat was *C. crisbis* >*N. unicorns* > *P. maculatus*. The order of mean and range of ash was ***N. unicorns*** and *P. maculatus* >*C. crisbis.* The gross chemical composition of fish varies from one species to another and within the same species depending on the type of food available for these fish, depths and locations in which they live, age and weight, sex and environmental conditions. This was derived from the findings of El Gray, (1999) [23] on *C. fulvoguttatus*, *C. rogga* and *E. carunculus*; Macovei *et al*., 2009 [24] on cyprinds; Ahmadoon (2013) [25] on *P. aeronauts*, *C. mate* and S. *barracuda*, and with Nogueira *et al*. (2013) [26] who worked on Northeastern Atlantic: *A. carbo*, *S. fasciata*, *P. phycis*, *S. scrofa*, *D. sargus*, *P. kuhlii*, *P. saltatrix*, *S. atricauda*, *D gibbosus*, *P. pagrus*, *T. picturatus*, *S. colias* and *P. dentex*.

The significant difference in the percentage of moisture between meats of the studied fish species were at 0.05% significance level, especially among the ***C. crisbis*** in which the percentage ratio decreased to 60.8% compared to the percentage rate the moisture in the meat of ***P.maculatus***, and *N. unicorns*, which amounted to 68.6% and 65.7% (respectively), it can be noted that the sum of the percentage of moisture and the percentage of fat in the meat of fish of the three fish tested was approximately range between 72% to 77%. It is likely that the differences in chemical composition are species related. Recognized that the sum of the percentage of moisture and fat of fishes usually range around 80%. Thus, the moisture content of the studied fish may be considered an indicator of the percentage of fat in them. The relationship between the percentage of moisture and the percentage of fat, was found to be inversely related by Jason (2006) [31] and Ihekoronye and Ngoddy (1985) [13]. Those authors indicated that an increase in moisture is accompanied by a decrease in fat, and vice versa.

The current study showed extremely highly significant difference ($p<0.000$) in protein among the three fish species. The protein percentage was higher in the meat of ***P. maculatus*** (26.14%). A small difference was found between the mean percentage of protein in ***C. crisbis*** and ***N. unicorns*** (23.75 and 22.28%), respectively. It is likely that as a result of the low protein content in both fish (***C. crisbis*** and ***N. unicorns***) they lose more water during the cooking process, compared with the meat of *P. maculatus*. This probably leads to distortion of its texture after cooking. The reduced amount of protein in fish affects the quality and the texture of the fish meat (Nair, 2006; Barua *et al*., 2012**)** [17, 6].

Balla (1999) [32] worked on the chemical composition of *S. jello* and *S. caudimaculyum* and reported moisture ranges from 77 to 79.8%, protein ranges of 77.9 to 89.2%, fat from 2 to 10%, ash from 3.5 to 8.5%; and *moisture* for *75* to *79%*, protein from 68.1 to 82%, fat from 10 to 25% and ash from 4.5 to 5.8%, respectively. Eltaher (2000) worked on *L. gibbus* and *N. unicornis.* He from *L. gibbus* moisture from 74 to 75.6%, protein from 67.7 to 82.5%, fat from 24.4 to7.7% and ash from 6.2 to 7.5%, and for *N. unicornis* moisture was 74 to 76.7%, protein from 66.8 to 85%, fat from 5 to 24.3%, and ash from 5.4- 5.9%. Haroon (2000) studied the chemical composition of *C. rogaa* and *P. filamentosus*. For *C. rogaa*

the moisture comprised 72.67 to 76.70%, protein was from 79.50 to 84.50%, fat from 8 to 11.06% and ash from 5.59 to 6.20%. For *P. filamentosus* moisture was from 69.33 to 77.33%, protein was 83 to 90%, fat from 1.4 to 7.22% and for ash 4.0 to 7.07%.

According to Exler (1987) [10] and Barua *et al*. (2012) [6] and Nair (2006) [17] fishes are generally rich in minerals which are needed by the body. In Sudan, marine wet salted fish especially those from *Mugil cephalus*, *Chanos chanos* and *Gibbus* spp.; and those prepared from fresh water fishes such as *Hydrocynus* spp., *Alestes* spp. and *Labeo* spp. are minced as a whole fish availing a highly rich source of calcium.

Barua *et al*. (2012) [6] highlighted the physicochemical basis of the biologic properties of mineral trioxide aggregate.

4.2. Nutrition value and caloric value:

The nutritional merit of fish species is also useful in reclassification of as grade I, II and III (Babiker, 1981) [27].

Balfego *et al.* (2016) [5] found that sardine enriched diet is useful on metabolic control, inflammation and gut micro biota in patients with type 2 diabetes. The protein component is the building block for new tissues and repair and compensation for damaged ones. Fish depend mainly on the supply of protein from food because her body has a very limited ability to synthesize amino acids protein building blocks. Therefore, the protein level in food is considered factor seasonal changes in the chemical composition of fishes. A determinant of fish growth, especially breeding, under conditions of rearing where a building is needed for gonads and their evolution to convert important amounts of body proteins that must food compensation (Chong *et al*., 2004) [9]. The percentage of protein in the tissues varies according to many factors, the most important of which is the physiological condition and the healthy and reproductive of fish Barua *et al*. (2012) [6]. To determine quality and the effect of diet on growth performance, it is of prime importance to determine the components of total fat and protein in the dietary. In the present study aggregate measurement, such as total dietary protein, fat was done to determine quality of diet dietary composed from the three fish species (*P. macultus, N. unicorns and C. crisbis*). In the present study the nutritional value was measured, fat: protein ratio is also measured for the three species study, and it is appeared that the highest protein fat percentage was showed in *N. unicorns* 0,237 followed by *C. crisbis* 0.186 and the lowest for *P. macultus* 0.170. Thus the caloric value in the three species is the highest record was for *P. macultus* followed by *C. crisbis* and the lowest for *N. unicorns*.

4.3. Growth experiment

Shariatmadari (2000) [28] related success of poultry production and their industry in Iran to appropriate feeds. The aim of these feeding growth experiments is to find out the efficiency feeding of the three studied fish species on poultry growth performance. Fish meal is largely available and the most cheaply conventional animal protein source for poultry. Fishmeal is a brown powder which normally contains a high level of protein and appreciable quantities of fat and minerals (Anonymous, 2002) [4]. The influences of different feed component from the three fish species and control on chick performance showed that no significant different (p>0.05) between body weight of chick through the period of experiments. But on some days of the experiments, we find that there is a clear distinction in the weight gained of poultry according to the component of the fish diet of the three fishes. It is also noted that there is a gradient in the weight gained, starting from a weight not exceeding 70 grams until the 17th day to an acquired weight of more than 300 grams from the twenty-fifth day. With a distinction for the comparative experiment (control) of growing chicks from the other three fish, also we find a distinction on growth weight of poultry that feed with *P. maculatus* diets during first seventeen days of the experiment, at the end of the experiment period (25-41 days), the growth weight gained of the chicks is roughly the same. The final mean growth weight of the chicks is apparent distinction due to the effect of feeding experiment by *P. maculatus* followed by *C. crisbis*, with clear difference from the control diet. These findings are consistent with the present results of this study. The present finding showed that the highest protein and calorific values were recorded for *P. maculatus.* The calorific value was significantly higher than that for *C. crisbis* and *N. unicornis.*

The present study aimed to evaluate the impact of fishmeal on chick growth. A completely randomized design with four treatments and three replicates of five birds each was used. The experiment lasted 41 days. The three fish species used as a source of fishmeal yielded chick body weight gain 20% lower than that of the control.

Fishmeal is an excellent source of protein for poultry. It is made from fish, filleting waste from the processing of the fish and the by-products. These are ground, cooked, processed and converted to fishmeal a high protein feedstuff**.** Feeding experiments were conducted to assess the feeding value of fishmeal in broiler and for use in animal feeds (Yamane *et al*., 1982; Hammoumi *et al*., 1998; Karimi, 2006; Jassim, 2010; Cho and Kim, 2011; Silva *et al*., 2017) [33, 34, 15, 14, 8, 21]. Fish meal is of value in promoting aquaculture yield (Miles and Chapman, 2005) [16].

Fishmeal contains a good balance of amino acids, including methionine and lysine. In addition to high levels of essential amino acids, fishmeal has a good balance of unsaturated fatty acids, certain minerals like calcium and phosphorus, and vitamins A, D, and B-complex (Yamane *et al*., 1982; Cho and Kim, 2011) [8, 22].

Hammoumi *et al.* (1998) [34] found that animal waste represents a vast source of energy and nutrients that can be converted into fishmeal for the animal feed industry. This alternative represents a great potential for use of capture and processing losses of fish processing.

In developing countries, imported fish meal is a traditional protein source for broiler production. The cost is dependent on the world supply and demand for the product (Karimi, 2006) [15]. Fish meal is valued by farmers and nutritionist in these countries because it contains highly digestible crude protein and essential amino acids as well as fat, vitamins and minerals (Cho and Kim, 2011) [8]. Jassim (2010) [14] studied the effect of using local fishmeal from *Liza abu* as protein concentration in broiler diets. Jassim (2010) [14] found that the percentage of carcass protein significantly (p<0.05) increased, while the percentage of fat significantly (p<0.05) decreased.

Karimi (2006) [15] recognized that generally, fish contains an equal proportion of nutritional values of protein, with some different on the fat to protein ratio. Also fish diet intake by chick can be affected by difference means such as the types of fish's intake, time, and age of chick. Karimi (2006) [15] found that fish intake depends largely on different environmental factors such as availability of food, water temperature and the preference of fish for a particular type of feed. Tilami and

Sampels (2017) on nutritional value of fish lipids, proteins, vitamins, and minerals. The results of the questionnaire supported this hypothesis. We see that as recognized by (Oppenheim, 1992) [29]. The questionnaire is a method for evaluation, but it depends a lot on cultures and temper of the respondent. Often times, questionnaire results may differ from scientific facts (McDowell and Newell, 1996) [30]. Application of questionnaires as a method of data collection in research is well established with the benefits and drawbacks of using such a method (Oppenheim, 1992) [29]. What is less evident in the literature is a consideration of the process of delivering questionnaires to large groups. Through the questionnaire in the present study, we found that there is a distinction of the preference for the *P. maculatus*, although it is not of high nutritional quality than the other two types. The general appearance, such as colour, texture, and taste may play a role in favoring one type over on other (Alkhalaf and Khareet, 2014).

According to Alkhalaf and Khareet (2014) some consumers prefer fish with high fillet yield, and some do not like fish with high size of visceral or stomach, or tiny and numerous spines or high amount of skeleton.

9. References

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