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Nutritional composition and amino acid profile of the crayfish byproduct meal

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ABSTRACT

The present work aimed to study the chemical composition and quality criteria of crayfish by-products and utilization of these wastes to reduce environmental pollution and produce economic crayfish meal. Also, chemical composition, amino acid composition, and bacteriological evaluation of crayfish meal were carried out. The results showed that fresh crayfish wastes contained 72.15±0.22% moisture, 15.30±0.09% protein, 3.25±0.02% fat, 8.95±0.11% ash, 0.35±0.01% carbohydrates, 15.06±0.05 TVB-N (mg/100g), 0.45±0.01 TMA (mg/100g) and 0.18±0.01 TBA (mg MDA/kg) (on wet weight basis), while pH value was 6.72±0.12 and 4.30 ±0.06 TBC (log_{10} cfu/g). On the other hand, crayfish byproducts meal had 7.35± 0.95% moisture, 61.75±0.22% crude protein, 6.02±0.09% fat, 23.66±0.06% ash, 1.22±0.05% carbohydrates, and 21.15% yield. Also, the high nutritional quality crayfish byproduct meal was confirmed by the high of total amino acids (TAA, 73.90 g/16g N), total essential amino acids (TEAA, 34.62 g/16g N), amino acid index (AAI, 67.66%), and biological value (BV, 67.66 %). Total bacterial count and thermophilic bacterial count were 2.71 and 0.35 log_{10}cfu /g sample indicated the high safety of crayfish meal. In conclusion, crayfish byproducts showed not be neglected because of the relatively high nutritional value, suggesting their use as feed additive during feeding chicks, chicken, and fish, i. e. as in the fish meal.

INTRODUCTION

The utilization of by-products (wastes) from different fisheries became increasingly important. The general trend in global marine capture indicates that the maximum long-term potential of global marine catches has been reached **(FAO, 2005).** Fortunately, the most of fish wastes are not longer considered just as waste but are used as raw materials for fish industries **(Arason, 2002).** The freshness of raw material is important if a producer wants to preparation premium high quality fish meal. Freshwater crayfish were recently introduced to the Egyptian Nile waters and were widely scattered in both the Nile River and its branches throughout Egypt. It has been collected during fishing from many locations at the northern parts of the River Nile **(Fisher, 2006 and El-Mossalami and Emara, 1999). El-Kholle *et al.* (2012)** reported that the inedible parts of crayfish

were 84.64 from live weight. Other studies have shown that the quantity of red claw crayfish by-products is represented approximately 78% of the total weight **(Jones, 1989).** The wastes from fisheries are often used to produce fishmeal and fish oil that used in animal feed, also, fish meal is the main dietary protein source in aquaculture feeds **(Hardy and Masumoto, 1990).** Fish meal can be produced from whole fish or wastes from the use of fish prepared for human consumption **(Ponce and Gernat, 2002).** Fish meal considered high quality because it is a good source of most amino acids; it includes high levels of lysine and methionine which complement their deficiency in plant protein supplements. it contains high levels of available lysine and methionine that counteract their deficiency in plant protein supplements. Also, fish meal contains most of the essential trace elements and the useful form of phosphorous **(Lall, 1991).** However, fish meal synthetic from fish filleting wastes and white fish contains too much level of ash. Lipid that presented in fish meal also contains 1-3% n-3 fatty acids, a source of fatty acids in fish diets. Many researchers studied fish meal, **Esmail (1977)** studied the processing of fish meal from bolti wastes obtained from Nasser's Lake, it contains 5.5% moisture, 36.2% crude protein, 6.5% fat and 51.8% ash and the yield of fish meal was 17% of the total wastes. **Hussein (1997)** reported that the yield of fish meal from bolti wastes was 20.04%. However, **El-Sherif (2001)** studied the chemical composition of fish meal made from Fayoum shrimp shells plus appendages and reported that the yield of shrimp meal was 18% of raw material. Shrimp meal is a high quality is a complete source of amino acids and is of good biological and nutritional quality, this indicates high essential amino acid index, biological value and protein efficiency ratio (**El-Sherif, 2001).** Therefore, the present work aimed to study the utilization of crayfish wastes for production fish meal high economic and nutritional value.

MATERIALS AND METHODS

Crayfish by-products: freshwater crayfish (*Procambarus clarkii*) average weight (40±5g) was obtained from both the Nile River and its branches from Giza to El-Minia Governorates and transferred to the laboratory with ice box to Fish Processing Technology at El-Kanater El-Khiria, Fish Research Station belonging to National Institute of Oceanography and Fishers. Crayfish meat was obtained by manually peeling, then removing the meat from the shells of the tail. the inedible part (wastes) represented about 82% from total weight. These wastes were used in the preparation of crayfish wastes meal.

Preparation of crayfish waste meal

The wastes were rinsed in clean water and a suitable quantity of wastes was added to equal its weight of water and cooked for one hour, the mixture was drained and pressed in cheese cloth to remove the liquor (stick water) from the cake that was dried, milled and sieved to obtain crayfish waste meal which packed in polyethylene bags and kept at low

temperature until the analysis of chemical composition and nutritional quality were carried out.

Analytical methods

Analyses were made on fresh crayfish wastes immediately after preparation, moisture content, protein content (N×6.25), lipid content and ash content were determined as recorded to in the methods recommended in **AOAC (2002).** Total volatile bases nitrogen (TVB-N) was determined using the macro distillation procedure decided by **Person (1991).** Trimethylamine nitrogen (TMA-N) was calorimetrically determined according to the official method of analysis **AOAC (2002).** Thiobarbituric acid (TBA) was calorimetrically determined according to the recommended method by **Pearson (1991).** The pH value was measured as the recommended method by **Woyewoda *et al.* (1986).** Total bacterial count (TBC) was estimated using the nutrient agar medium according to the method described by **FAO (1992).** Thermophilic bacteria counts were estimated after heating the original sample solution at 80°C for 15 minutes and their plating with above media by the same method used for the total bacterial count **(Gould and hurst, 1969).** Amino acid contents were determined as the described method by **Pellett and Young (1980).** Amino acids contents were determined by using EPPENDORF LC3000 qmino acid Analyze in National Research Center. Amino acid values were expressed as g/16gN and g/100g sample. To evaluation the nutritional quality and nutritional value of protein, essential amino acids index (IAAsI) was estimated and calculated as reported by **Hidvegi and Bekes (1983)** and the biological value (B.V. %) was calculated as recomended by **Oser (1959)** as follows: $(\text{B.V.} = 1.09 \times \text{EAAI} - 11.73)$. Data were expressed as mean ± S.E.

RESULTS and DISCUSSION

Crayfish byproducts

Chemical proximate composition and quality properties in crayfish byproducts

The obtained results in Table (1) showed that the fresh crayfish wastes had the following contents; the moisture 72.15%, the protein 15.30%, lipid 3.25%, ash content 8.95%, and carbohydrates content 0.35% (on wet basis). The obtained results were in accordance with those reported for bolti wastes from Wadi El-Raiyan Lake by **Ibrahim (1998)** and shrimp wastes from Qarun Lake **(El-Sherif, 2001).** Also, the total volatile bases nitrogen (TVB-N), trimethylamine nitrogen content (TMA-N), thiobarbituric acid nalue (TBA), pH value and the total bacterial count (TBC) were determined to evaluate freshness, quality and safety of fresh investigated crayfish wastes. It could be found that fresh crayfish wastes contained 15.06 mg TVB-N /100g sample, 0.45mg /100g sample and 0.18 mg Malonaldhyde TBA/kg sample (wet basis), These results were lower than permissible limits; 30-40mg/100g sample for TVB-N **(Shen, 1996),** 3.79-3.90 for TMA-N **(Maga, 1978)** 3-27 mg/kg for TBA (Bonell, 1994), while pH value in crayfish wastes was 6.72. In addition, the same sample of crayfish wastes had 4.30 Log_{10}cfu/g TBC was

lower than recorded by **ICMSF (1986)** that limited (5×10^5 -10^7 cfu /g) for fresh fish. These obtained results are harmony with those reported by **El-Sherif (2001).** These results indicated the high freshness and safety of crayfish wastes for processing and production crayfish meal.

Table (1). Chemical composition, physicochemical and microbiological quality properties (on wet weight basis) of crayfish byproduct

Parameters (%)	Means± S.E.	Parameters	Means± S.E.
Moisture	72.15 ±0.22	TVB-N (mg/100g sample)	15.06 ±0.05
Protein	15.30 ±0.09	TMA (mg/100g sample)	0.45 ±0.01
Lipid	3.25 ±0.02	TBA (mg Malonaldhyde/kg sample)	0.18 ±0.01
Ash	8.95 ±0.11	pH value	6.72 ±0.12
Carbohydrates	0.35 ±0.01	TBC ($\log_{10}$ cfu/g)	4.30 ±0.06

Note: Values are mean ± S.E. of 3 replicates.

Crayfish byproduct meal

Chemical composition of crayfish meal

From data presented in Table (2), it could be found that crayfish meal had 7.35 % moisture, 61.75% crude protein, 6.02% fat, 23.66% ash and 1.22% carbohydrates. By comparison these results with obtained data in Table (1) crayfish wastes, it could be noticed that moisture content was decreased for crayfish meal, this may be due to the press drying method with separation of stick water and drying processing. While, crude protein, fat, ash and carbohydrates were increased, this could be due to the decrease of moisture. Also, the presented data illustrated that the yield of crayfish meal was 21.15% of the total crayfish wastes. These results are similar to those reported by **Esmail (1977), Hussein (1997) and El-Sherif (2001).**

Table (2). Chemical composition and yield of crayfish meal

Parameters	Moisture %	Crude protein %	Crude fat %	Ash%	Carbohydrate %	Yield %
Means ± S.E.	7.35±0.95	61.75±0.22	6.02±0.09	23.66±0.06	1.22±0.05	21.15

Amino acid composition and nutritional value of crayfish meal

From Table (3) it could be noticed that the protein in a crayfish meal has a high biological value in diets for animals; it's 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 will supplement any deficiencies of the amino acids in vegetable proteins. Also, the nutritional quality was confirmed by the high of total amino acids (TAA), total essential amino acids (TEAA), amino acid index (AAI) and biological

value (B.V. %). Where, TAA was 73.90 g/16gN, TEAA was 34.62 g/16gN, TEAAI was 67.66 g/16gN and B.V. was 62.02 %. Similar results were found by **Ghaly (1995), Hussein (1997) and El-Sherif (2001).**

Table (3). Amino acid composition and nutritional value of crayfish meal

Amino acids	g/16g N	Amino acids	g/16g N
Aspartic acid (Asp)	8.06	Tyrosine (Tyr)*	1.55
Threonine (Thr)*	3.21	Phenylalanine (Phe)*	3.12
Serine (Ser)	3.10	Histidine (His)*	2.03
Glutamic acid (Glu)	11.22	Lysine (Lys)*	7.21
Glycine (Gly)	4.18	NH_4	nd
Alanine (Ala)	5.20	Arginine (Arg)	4.66
Valine (Val)*	4.15	Proline (Pro)	2.86
Methionine (Met)*	2.52	Cystine (Cys)*	0.86
Isoleucine (Ile)*	3.02	Tryptophan (Try)*	nd
Leucine (Leu)*	6.95		
Total amino acid [TAA]	73.90		
Total essential amino acids [TEAA]	34.62		
Total essential amino acids index [TEAAI]	67.66		
Biological value (%)	62.02		

**: Essential amino acids, nd: not detected*

Bacteriological evaluation of crayfish meal

Total bacterial count (TBC) as well as thermophilic bacteria was examined in the investigated crayfish meal obtained from crayfish wastes to assessing the bacteriological quality and the obtained data are tabulated in Table (4), the obtained data illustrated that (TBC) and thermophilic bacterial count were 2.71 and 0.35 log_{10}cfu/g sample. This decrease in microbial count in crayfish meal compared with fresh wastes TBC (4.30 log_{10}cfu /g) might be due to the many of microorganisms were removed with separated stick water and the effect of heat during processing.

Table (4). Bacteriological aspects of crayfish meal

Bacteriological assessment	Log_{10} cfu/gm
Total bacterial count (TBC)	2.71±0.08
Thermophilic bacteria	0.35±0.02

Values are mean ± S.E. of 3 replicates

CONCLUSION

Any way the crayfish wastes showed not be neglected because of the relatively high nutritional value, suggesting their use as feed additive during feeding chicks, chicken and fish, i. e. as in the fish meal.

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