

## Evaluation of Production and Quality of Salt-Biscuits Supplemented with Fish Protein Concentrate

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**Abstract:** The quality and nutritional value for both fish protein concentrate (FPC) made from tilapia by-products as well as salt-biscuits supplemented with 5% FPC were evaluated. The resultant product (FPC) was composed (on wet weight) of 4.18% moisture, 68.83% protein content, 0.75% lipid and 25.39% ash and it was more uniform in color and texture. In addition, the pH value was 6.67 and total volatile basic nitrogen (TVB-N), timethylamine nitrogen (TMA-N) and thiobarbituric acid (TBA) values were 7.18 mg/100 g, 0.84 mg/100 g and 0.05 mg Malonaldehyde/ kg sample, respectively. Concerning nutritional value, FPC at 5 % level played an important role in water holding ability, increased protein content, especially essential amino acids (EAAs) and did not affect appearance and other characteristics of salt- biscuits. In conclusion, fish by-products are considered a valuable source to supplement some bakery products.

**Key words:** Fish wastes • Fish protein concentrate • Nutritional value • Salt-biscuits

### INTRODUCTION

Fish wastes represent a high risk for environment. For example, the tilapia industry has grown significantly and considerable processing waste is produced, whereas only the myomere (fillets) muscles are marketed. These portion constituents approximately 36 % of the fish and leaving 64 % of the fish as waste which is lost during the various processing operations. This waste recovered from the tilapia processing plant has the potential of being an alternative protein source [1].

Fish Protein Concentrate (FPC) has been defined as the product resulting by removing of water and oil from fish, thus increasing the concentration of the protein and other nutrient materials. The quality of the materials used to prepare FPC will influence the quality of the produced material. Also, it is an excellent source of highly digestible amino acids, but its costs normally limit its usage. However, it has poor functional properties and can be categorized into three grades; A, B and C based on its quality and degree of refinement [2] and it was found to promote weight gain and nitrogen retention as milk [3&4]. In the same time, most of the effort directed towards improving the diets of people is centered on the improvement of the protein content and quality of

cereals by the addition of protein-rich foods, protein concentrates and/or essentials amino acids [5]. Several workers have been achieved fortification of different household common foods by FPC [6]. Also, it was found that 6% FPC is the best level for supplementation of biscuits [7] and 10 % FPC increased nutritional value and percent of satisfaction values for some common foods [8], Salt biscuits supplemented with 5% fish protein isolate (FPI) improved the overall acceptability [9].

The current investigation was carried out to evaluate the nutritional value of both fish protein concentrate (FPC) made from tilapia by-products as well as salt-biscuits supplemented with 5% FPC.

### MATERIALS AND METHODS

**Materials:** Raw tilapia by-products (heads, viscera, skin and bones) were collected from some fish processing markets, El-Qanatir El-Khiria city, El-Qaloubia, Egypt during 2006. Samples were cleaned and carefully washed with tap water. Fish protein concentrate (FPC) was prepared as outlined by Zaitsev *et al.* [10]. Salt-biscuit was manufactured according to Dovaldk and William [11] and supplemented with 5% FPC.

**Analytical Methods:** Samples for proximate composition (moisture, protein, lipid and ash content) and Timethylamine nitrogen (TMA-N) were analyzed as outlined by AOAC [12]. Carbohydrate was calculated by difference. The pH value, total volatile basic nitrogen (TVB-N) and thiobarbituric acid reactive substances (TBARS) were determined as reported by Pearson [13]. Individual amino acids were determined using reverse phase HPLC; hydrolysis, derivatization and analysis were performed according to the Pico-Tag method [14]. Tryptophan was not determined.

**Microbiological Analysis:** Samples of 10 g of FPC were suspended in 90 ml sterile saline (0.85% NaCl). Decimal dilutions were plotted to determine total viable count as  $\log_{10}$  cfu/g [15].

**Sensory Evaluation:** The sensory evaluation of baked biscuit was estimated by ten panelists for appearance, odor and taste as the method described by Gerczyca and Zabic [16].

**Statistical Analysis:** The mean and standard error (mean  $\pm$  SE) for the obtained results were calculated using SPSS computer program under window [17].

## RESULTS

The proximate analysis of raw tilapia-by products is presented in Table 1. Results showed that the proximate analysis (on wet wt. basis) of raw tilapia-by products contained 72.23% moisture, 17.27% total protein, 4.81% lipid and 5.48% ash. The corresponding values of produced FPC were 4.18, 68.83, 0.75 and 25.39% ash content as shown in Table 2. The yield obtained of FPC was 13.64%.

Table 1: Proximal analysis of raw tilapia-by products

Constituent (%)	Raw tilapia wastes
Moisture	72.23 $\pm$ 0.25
Crude protein	17.27 $\pm$ 0.96
Lipid	4.81 $\pm$ 0.13
Ash	5.48 $\pm$ 0.03

Values represent means  $\pm$  SE for 3 determined replicates

Table 2: Proximal analysis and quality criteria of FPC

Constituent (%)	FPC	Criterion	Value
Moisture	4.18 $\pm$ 0.21	pH	6.67 $\pm$ 0.02
Crude protein	68.83 $\pm$ 0.17	TVB-N (mg/100 g)	7.18 $\pm$ 0.98
Lipid	0.75 $\pm$ 0.11	TMA-N (mg/100g)	0.48 $\pm$ 0.07
Ash	25.39 $\pm$ 0.07	TBARS(mgMalonaldehyde/kg)	0.05 $\pm$ 0.02
Yield	13.64	TVC ( $\log_{10}$ cfu/g)	3.74 $\pm$ 0.08

Values represent means  $\pm$  SE for 3 determined replicates

Table 3: Proximal analysis of control and salt-biscuit supplemented with 5% FPC.

Constituent (%)	Control	Salt-biscuit with 5% FPC
Moisture	13.92 $\pm$ 0.18	17.31 $\pm$ 0.07
Crude protein	10.05 $\pm$ 0.41	12.50 $\pm$ 0.94
Lipid	22.60 $\pm$ 0.21	22.65 $\pm$ 0.19
Ash	7.24 $\pm$ 0.10	7.28 $\pm$ 0.06
Carbohydrate	46.19	40.26

Values represent means  $\pm$  SE for 3 determined replicates

Table 4: Amino acids composition (g/100g sample) of FPC

Essential Amino acids	g/100g	Nonessential Amino acids	g/100g
lysine	0.08	Aspartic	26.16
Therionine	0.06	Glutamic	28.56
Valine	2.66	Arginine	0.08
Methionine	1.46	Tryptophan	*n.d.
Isolucine	0.87	Serine	nil
Leucine	2.34	Proline	0.46
Phenylalanine	1.64	Glycine	nil
Histidine	1.55	Alanine	0.72
Tyrosine	0.95	Arginine	0.08
Cystine	1.16		
Total (a)	12.77	Total (b)	56.06
Grand (a + b)	68.83		

\*n.d: not determined

The Quality parameters for FPC are shown in Table 2. The pH value was 6.67, while the values of TVB-N, TMA-N and TBA were 7.18 mg/100g, 0.48 mg/100g and 0.05 mg Malonaldehyde/kg sample, respectively. Concerning bacterial load, the recorded TVC is 3.74  $\log_{10}$  cfu/g samples.

The proximate analysis for both control salt-biscuit and salt-biscuit supplemented with 5% FPC are shown in Table 3. Salt-biscuit (control) contained 13.92% moisture, 10.05% crude protein, 22.60% lipid, 7.24% ash and 46.19% carbohydrate content. On the other hand, FPC-biscuit contained 17.31%, moisture, 12.50% crude protein, 22.65% lipid, 7.28% ash and 40.26% carbohydrate content.

**Nutritional Value:** Amino acids composition of FPC, salt-biscuit (control) and biscuit supplemented with 5% FPC are presented in Table 4. Total AAS averaged 68.83 g/16 g, total essential AAS (TEAA) and non essential Aas averaged 12.77 and 56.06 g/100g (wet sample), respectively.

Table 5 shows the amino acids composition (g/100g sample) for salt-biscuit (control) and biscuit supplemented with 5% FPC. Total EAAs were 3.59 and 3.66 g/100g sample in Salt-biscuit (control) and 5% FPC-salt-biscuit, respectively. Besides, the corresponding values of non EAAs were 6.48 and 8.85 g/100g sample, respectively.

Table 5: Amino acids composition (g/100g sample) of Salt-biscuit (control) and supplemented with 5% FPC

Essential Amino acids	Salt-biscuit (control)	5% FPC- Salt-biscuit	Nonessential Amino acids	Salt-biscuit (control)	5% FPC- Salt-biscuit
lysine	0.18	0.03	Aspartic	2.70	5.29
Therionine	0.27	0.08	Glutamic	1.09	1.57
Valine	0.43	0.21	Arginine	0.56	0.51
Methionine	0.15	0.80	Tryptophan	*nd	*nd
Isolucine	0.34	0.09	Serine	0.50	0.69
Leucine	0.65	0.37	Proline	1.10	0.18
Phenylalanine	0.81	0.23	Glycine	0.24	0.44
Tyrosine	0.24	0.69	Alanine	0.25	0.17
Histidine	0.22	0.74			
Cystine	0.30	0.42			
Total (a)	3.59	3.66	Total (b)	6.48	8.85
Grand (a + b)				10.03	12.51

\*n.d: not determined

Table 6: Mean values for the sensory tests of salt-biscuits supplemented with 5% FPC

Characteristic	Control	5% FPC-Salt biscuits	*L.S.D at 0.05
Color	8.7	8.4	0.78
Odor	8.9	8.5	0.40
Taste	8.8	8.6	0.23
Overall acceptability	9.0	8.7	0.81

\*L.S.D: Least significant difference

**Sensory Evaluation:** Mean values for sensory tests of both salt-biscuit (control) and biscuit supplemented with 5% FPC are presented in Table 6. Taste panel tests showed no significant changes (LSD = 0.05) between control and that supplemented with 5% FPC. However, the overall acceptability of biscuit supplemented with FPC was similar with control product.

## DISCUSSION

The present work proved that raw tilapia wastes are generally considered as a good source to produce FPC, this finding was previously confirmed by Ibrahim [18]. Also, proximate composition of FPC was varied relatively as compared to El-Sherif [9]. Low water content of FPC in this study was essential for preventing microbial growth and to attain a good keeping quality [3,4]. In addition, the obtained product can be classified as grade (A) based on lipid content [2]. Concerning quality criteria, low levels of TVB, TMA and TBA indicated that raw materials used had high quality. Similar findings were reported by El-Sherif [19], Hussein [20] and Heu [21].

FPC was more effective for supplementing biscuits whereas, it maximizing the amount of moisture and protein content. This data is in agreement with those found by El-Sherif [9]. Moreover, the level used (5%) did not affect appearance and other characteristics. Other studies were

carried out using five protein concentrate sources obtained from sunflower seed, soybean, lupine, rice bran and fish added to wheat bread at 5 and 10% levels. Moreover, it was found that the protein content in the enriched bread increased by values ranged from 16 to 62% [22]. The sensory evaluation showed that the protein sources were favorable supplements, especially at 5% level, however its ash content was high which must be removed by sieving. Similar findings were reported by Kvitka and Chen [6], Helal [8], El-Sherif [9] and Hussein [20].

In conclusion, Fish protein concentrate (FPC) made from tilapia by-products had high nutritional value. It is considered a solution to fish waste disposal problems as well as ingredient that can be incorporated in different formula such as salt biscuits.

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