J. Agric. Sci. Mansoura Univ., 32 (3): 2071 - 2083, 2007

EVALUATION OF FISH CAKES PROCESSED FROM BISSARIA FISH (*Atherina hepsetia*)

El- Sherif, S. A. A.

Fish Processing and Technology Lab., National Institute of Oceanography and Fisheries. (NIOF), Cairo, Egypt.

ABSTRACT

This work was carried out to study the utilizing of bissaria fish (*Atherina hepsetia*), which may be relatively small size, but its price is low and have a high edible part (70%) in processing of fish cakes. Substitution levels (10, 15 and 20%) of plant flours, Fababean (*Vicia faba*), chickpea (*Cicer arietinum*) and potatoes (*Solanum tuberosum*) were suggested to reduce the production coast and to improve the quality attributes of the products. Fish cakes were analyzed for their chemical, physical, microbiological and sensory properties. The obtained results indicated that the moisture content of substituted cakes was ranged from 51.75 to 55.12% as compared with control sample (49.15%).The range of TVB-N, TMA-N and TBA values(on wet wt. basis) of fried substituted cakes were (11.7 to 19.6, 0.28 to .82 mg/100 gm samples and 0.08 to 0.15 mg Malonaldhyde/kg sample ; respectively, compared with those of control (22.2, 0.96 mg/100 gm and 0.18 mg Malonaldhyde/kg sample). Regarding, physical properties, the cooking loss decreased and cooking yield increased by increasing plant flour levels, the cooking loss was higher in control sample(26.82%) than other fish cake products (11.35 to 20.15%). The lowest cooking yield was found in the control sample (73.18%) comparing with substituted cakes with plant flour which ranged 77.85-88.65%. Concerning the microbial aspects, the TBC was ranged from 3.04 to 3.49 log cfu /g sample in fish cake contained filling materials, while in control sample was 2.90 log cfu/g sample and the similar trends were observed in the (SFB), yeast and mould counts. Sensory evaluation results indicated that the incorporation of filling materials at 10% and 15% levels improved color, odor, taste, tenderness and overall acceptability scores for substituted cakes compared with control sample. In addition, bissaria fish cakes substituted with 15% of plant flours were more acceptability compared with the control and other prepared fishcake samples and took the following order: chickpea-cake followed potatoes-cake and fababean-cake. In amino acids analysis, bissaria fish cakes substituted with 15% of fababean, chickpea and potatoes flours were chosen the best treatment organolepticaly and determination amino acids for them was carried. The chickpea- cake samples showed better protein quality followed by fababean-cake and latterly potatoes- cake samples as indicated by higher values of IAAs, IAAI, BV%, PER and PS/100g % with lowering the GDR values. It could be recommended that bissaria fish can be utilized for production of fish cakes in a large scale with the addition of fababean, chickpea and potatoes flours (15%) to improve their quality attributes and to decrease the production coast of the final product.

Keywords: Fish cakes, Fababean flour, Chickpea flour, Potatoes flour, Quality criteria, Sensory evaluation, Amino acids.

INTRODUCTION

To obtain some ready-to-eat fishery products which have high quality and low price, bissaria fish have been used for this purpose In addition, plant flours have been used as fish meat extenders in the food service. Therefore, Akande (1991) reported that salted dried fish cakes can be produced from tuna mince, has low coast and suitable for distribution in rural and urban

areas at tropical ambient temperature without to need for refrigeration. Moreover, Akande *et al.* (1991) reported that the moisture content was (47.01%) and there is little difference in the lipid and protein contents of the deep fried fish cakes. They also found that total viable count was 5×10^2 cells/g of fish cakes. Atta, *et al.* (1993) investigated fish cakes manufactured from carp fish flesh with various incorporating filling material such as wheat flour, corn starch and gelatin to improve the binding and sensory attributes of the product. They found that the highest acceptability was recorded for fish cakes contained wheat flour at level 15%. Furthermore, Ghazi *et al*. (1993) concluded that carp cakes substituted by 15% wheat flour caused a remarkable reduction in crude protein and lipids contents, while carbohydrate increased. In addition, they found that the tenderness of fish cake decreased by addition of wheat flour. Also, Ibrahim (2004) investigated the effect of some filling materials i.e. potatoes, artichokes, borghul and their mixture at substitution levels of 5 and 10% on the chemical composition and quality criteria of carp cakes. He revealed that, moisture, protein, fat, ash ,carbohydrates and total energy of carp cakes were 47.01 to 57.19%, 19.0 to 25.50%, 15.21 to 19.18%, 2.32 to 3.07%, 5.13 to 7.76% and 237.09 to 295.58 kcal/100g sample; respectively (on wet wt. basis). In addition, the same author reported that the TVB-N, TMA-N and TBA values were 18.66 to 26.0 mg/100gm, 0.23 to 0.83 mg/100gm and 0.04 to 0.20 mg Malonaldhyde/kg for processed fish cake containing the filling materials, versus, 29.4mg/100gm, 0.89mg/100gm and 0.04mg Malonaldhyde/kg for the control sample on wet weight basis; respectively. Concerning cooking loss and cooking yield, Mostafa *et al.* (2002) observed that fried catfish patties realized the highest cooking yield (84.57%) followed by fried tuna fish patties (82.96%) when 15% soybean flour was used. While, Ibrahim (2004) reported that cooking loss of fried carp cakes substituted with artichokes, borghul, potatoes and mixture was ranged (13.0 to 23.55%) while, control (36.5%) and highest cooking yield was(87.0%) of treatments while, control was (63.5%). Therefore, mixing filling materials with minced fish might be achieved the texture of the final products as well as improving the economical side of production. So, this study was planned to study the effect of addition different filling materials such as fababean, chickpea and potatoes flours on the chemical, physical, sensory properties and nutritional value of fish cakes processed from minced bissaria fish flesh which have low price and high edible portion, as well as having a good quality and better acceptability.

MATERIAL AND METHODS

Materials:

Fish: The bissaria fish (*Atherina hepsetia*) obtained from Qarun Lake, Fayoum Governorate, Egypt. The average weight of each fish was 8-10 gm, the average of length was 10-12 cm and the edible part was about 70%.

Preparation of filling materials: filling materials source including Chickpea (Cicer arietinum) seeds, Potatoes (Solanum tuberosum) tubers and Fababean (Vicia faba) seeds were obtained from local markets at Fayoum Governorate, Egypt. Chickpea seeds were used as flour after cleaning, grinding, milling and sieved. Potatoes tubers were boiled for15min, and

handily peeled, minced, dried in oven at 60 ^{0}C for 6 hours and used as flour in the same manner as previously mentioned for chickpea. Fababean seeds were soaked in water acidified with acetic acid at ratio 20 ml acetic acid: 3000 ml water: 1000gm seeds for12 hr to reduce their content of antinutritional factors and to enhance their protein digestibility according to Paredes-Lopez *et al.* (1990), whereas they handily dehulled and boiled at 100 ^{0}C for 30 min. Boiled seeds were minced, dehydrated, milled and sieved as the same manner followed in potatoes flour preparation. All plant flours kept in polyethylene bags for the technological processing.

Preparation of fish cakes:

Bissaria fish washed thoroughly by tap water, beheaded and gutted manually; the residue part (edible) was minced using Electrical mincer (BRAUN power plus 1300). Minced fish was soaked in 1% salt solution contain 0.5 % acetic acid for 5 min to remove fishy odor and tasting components. Then the soaked fish minced were drained off and kept in four polyethylene bags for the technological processing. Fish cakes were manufactured as described by Akande *et al.* (1991).The first part of minced fish treated as control (without addition any filling materials), another parts were mixed with filling materials (Fababean, Chickpea and Potatoes flours) rehydrated with water at the ratio 1:2 water at ambient temperature (about 30 ^{0}C) before addition to produce cakes having different levels of substitution 10, 15 and 20% as indicated in table (1). Other ingredients incorporated in all cakes batches as shown in table (2) were minced thoroughly again. Each batch (50 gm) subjected to pressure using plastic template (8 cm diameter and 1.5cm thickness) to form fish cake. The prepared cakes were deep-fried using electrical fryer (MOULINEX brand) in sunflower oil heated at 170 ^{0}C for10 min., drained in basket to remove excess oil and cooled under ambient temperature (30 ^{0}C), then packed in polyethylene bags for analysis.
The levels of all plant substitutes as binders of bissaria mince are shown in

Table (1): Levels of plant flour (Fababean, chickpea and potatoes) used in bissaria minced blends.

Minced bissaria (gm)	Plant substitutes (gm)	Level of substitution (%)
87.80	-	0
79.02	8.78	10
74.63	13.17	15
70.24	17.56	20

Table (2): The other ingredients incorporated in bissaria cake samples.

Ingredients	(%)	Ingredients	(%)
Chopped onion fresh	3.00	Black pepper	0.20
Chopped garlic fresh	1.00	Red pepper	1.10
Tomato sauce	4.00	Thyme	0.02
Vegetable oil	2.00	M S G	0.06
Salt	0.70	Curry	0.02
		Cumin	0.10

Analytical methods:

Gross chemical components including moisture, protein (Nx6.25), fat and ash contents were determined according to the method described by A.O.A.C., (2002) Total carbohydrates estimated by difference. Total volatile basis nitrogen (TVB-N) and Thiobarbituric acid (TBA) were estimated as described by Pearson, (1991) Trimethylamine nitrogen (TMA-N) was determined according to A.O.A.C., (2002). The pH value was measured as described by Woyewoda ***et al***. (1986). Amino acids composition was determined according to Millipore Co-Operative (1987). Values of amino acids were express as (g/16gm N) and (g/100 gm sample). Amino acid score (AS) calculated for each indispensable amino acid in relation to FAO/WHO/UNU reference protein pattern, (1985). Indispensable amino acid index (EAAI) was calculated according to Oser, (1959). Also, Biological value calculated according to Oser, (1959) using the following equation: BV= 1.09 (EAAI) -11.73. Protein efficiency ratio (PER) was calculated according to Alsmeyer ***et al.*** (1974) using the following equation: PER= -0.684 +0.456 (Leucine) - 0.047(proline). Total bacterial counts (TBC), yeasts and molds were examined as described by FAO, (1979). Spores forming bacteria counts were enumerated on plate count agar after heating at 80^0C for 15 min. (Gould and Hurst, 1969). Sensory evaluation of fried cakes was carried out according to the method described by Smith ***et al***. (1973). Fried cakes were served to 10 panelists. The panelists were asked to evaluate color, taste odor, texture and overall acceptability using 10 hedonic scales points. A score of 10 being "like extremely", while1.0 being "disliked extremely". The data "judges results" were analyzed statistical using the least significant difference test (L.S.D.) as outlined by Steel and Torri, (1980).

RESULTS AND DISCUSSION

Chemical composition and quality attributes of fresh bissaria flesh:

The results presented in table (3) showed that the fresh bissaria fish flesh composed 75.02% moisture, 17.15% crude protein, 4.26% crude fat, 3.25% ash and 0.32% carbohydrate contents (on weight wt. basis).

Table (3): Chemical composition, quality criteria and microbiological aspects of fresh bissaria minced. (on wet wt. basis)

Constituents %	Wet wt. basis	Quality criteria	Wet wt. basis	Microbiological aspects	log_{10} cfu/gm
Moisture	75.02	TVB-N	16.2	TBC	2.78
Protein	17.15	TMA-N	0.92	Spore forming	2.04
Fat	4.26	TBA	0.26	bacteria.	
Ash	3.25	pH	6.30	Yeasts & moulds	2.18
Carbohydrates*	0.32				

***: Calculate by difference.**
TVB- N Total volatile basic nitrogen (mg/100gm sample)
TMA-N: Trimethylamine nitrogen (mg/100gm sample)
TBA: Thiobarbituric acid (mg Malonaldhyde /kg sample)
TBC: Total bacterial count (log_{10} colony forming unit/gm)

It could be noticed that bissaria flesh contained high protein and fat contents, nevertheless it is negligent from consumers this may be due to the small size of bissaria fish. Therefore, in this study bissaria fish was used for production of economic fish products.

Concerning freshness criteria, bissaria flesh had 16.2 mg TVB-N /100 gm sample, 0.92 mgTMA-N /100 gm sample, 0.2 mg Malonaldhyde / kg sample (on weight wt. basis) and pH value of was 6.30. Moreover, microbiological load (TBC), spore forming bacteria (SFB), yeast and mould counts were 2.78, 2.04 and 2.18 log10 cfu/gm sample.

These results are in agreement with those reported by Bonnel (1994) who reported that fish and fish products of good quality would have TBA value less than 2 mg Malonaldhyde/kg sample, while poorer quality fish will have 3-27 mg/kg. Therefore, fish with TBA number greater than 2 will smell and taste. In the same line, Connel (1990) observed that the TVB-N value is useful for estimating the freshness of lean fish and suggested 30-40 mg /100 gm for freshwater fish and 60 mg/100 gm for marine fish (on fresh weight basis). In addition, Maga (1978) reported that perfectly fresh fish had 3.37 mg/100 gm of TMA- N; good grade fish showed 3.79-5.90 mg /100 gm and fair fish had 12.65-16.02 mg /100 gm. While, spoiled fish contained as high as 59.01 mg /100 gm. In addition to the results which found by Shen (1996) who found that the total plate count of fresh fish $>10^4$ cells/gm, sub fresh 10^4-10^6 cells/gm and deteriorated fish $< 10^6$ cells/gm. These high levels had not been observed in freshness parameters of investigated bissaria fish flesh, therefore it characterized with a high freshness and a healthy safe quality of flesh for processing fish products.

Chemical composition of fried bissaria cakes:

As shown in table (4) the decrease in moisture content by frying was less pronounced in substituted cake batches by different levels of plant flour, especially in potatoes-cake when compared with control cake. These results may be attributed to the higher carbohydrates content in substituted cakes, which reduce the loss in moisture. The moisture content of substituted cakes was ranged 51.75 to 55.12%, as compared with control sample (49.15%), these results were in parallel with that reported by Akande ***et al.*** (1991). Therefore, it was cleared that incorporation of the filling materials improved the water binding ability of cakes, especially in the case of potatoes-cake followed by fababean-cake and chickpea-cake. In addition, the moisture content was increased in all treatments by increasing levels of filling materials; however, all substituted cakes had higher moisture than control sample.

On the contrary, the protein content was higher in control cake (24.2% on wet wt.) when compared to the other samples substituted with plant flours, this means that substituted materials are considered carbohydrate not protein source as shown in the former table. On the other hand, it was observed that chickpea-cake had higher protein (20.80 to 22.50%) followed by fababean-cake (18.13 to19.65%) and potatoes- cake (15.85 to18.54%) and the protein content was decreased in all treatments by increasing filling materials levels.

Table (4): Gross chemical composition (on wet wt basis) of bissaria cake substituted with different levels of plant flours

Constituents (%)	Control cake	Bissaria cakes substituted with:								
		Fababean flour			Chickpea flour			Potatoes flour		
		10%	15%	20%	10%	15%	20%	10%	15%	20%
Moisture	49.15	52.75	53.35	54.10	51.75	52.15	53.22	54.25	54.95	55.12
protein	24.20	19.65	19.00	18.13	22.50	21.90	20.80	18.34	17.52	15.85
Crude fat	18.35	16.80	16.15	15.45	15.75	15.05	14.58	15.20	14.13	13.96
Ash	4.65	5.05	5.38	5.42	4.85	5.18	5.25	4.70	5.02	5.39
Carbohydrate	3.65	5.75	6.12	6.90	5.15	5.72	6.15	7.51	8.38	9.68
Total energy K cal/100g	**276.6**	**252.8**	**245.8**	**239.2**	**252.4**	**245.9**	**239.1**	**240.2**	**230.8**	**227.8**

These results are agree well with those reported by Akande *et al*. (1991) they found that protein content was (18.2% on wet wt. basis) in fish cake, while, it was (19.0-25.5% on wet wt. basis) by Ibrahim(2004). The fat content was (18.35% wet wt.) in control cake, it was higher in control sample than other treatments (13.96-16.80% on wet wt. basis). In addition, the fat content was decreased in all treatments by increasing filling materials levels. In general, fat content was higher in all investigated cakes than that (8.2%) reported by Akande *et al.* (1991). Concerning ash, the ash content (4.65% on wet wt. basis) was lower of control cake than other treatments .The ash content was increased in all treatments by increasing filling materials levels. From the same table, it could be noticed that carbohydrates content increased in all treatments cakes than control sample. It was markedly increased by increasing filling materials levels. While, concerning total energy, the investigated fried bissaria cakes were found to be a good source of energy, since 100g of sample proved (227.76 to 276.55 k cal).Total energy was decreased in all treatments by increasing filling materials levels. However, all investigated fried bissaria cakes had higher energy than those found by Akande *et al*. (1991) who reported that deep fried cake had 210.4 k cal/100gm sample. These results are in agreement with those reported by Ghazi *et al.* (1993) and Ibrahim, (2004).

Quality criteria of bissaria cakes:

The TVB-N, TMA-N and TBA were taken by many investigators as a good index for the freshness case and to assess quality of fish and fish products (Nunes *et al.*1992).As illustrated in table (5) the TVB-N, TMA-N and TBA values of fried substituted cakes were ranged 11.7 to 19.6, 0.28 to 82 mg/100 gm samples and 0.08 to 0.15 mg Malonaldhyde/kg sample (on wet basis) respectively. However, these values were much lowered than those of control (22.2, 0.96 mg/100 gm and 0.18 mg Malonaldhyde/kg sample; respectively). This might be attributed to the added filling material. In addition, TVB-N, TMA-N and TBA values were lower in cakes contained potatoes flour than the other products. On the other hand, it could be also noticed that the same parameters were decreased by increasing substitution levels of filling materials indicating the importance of these extenders in minimizing TVB-N, TMA-N and TBA. These results are in agreement with those reported by Bonnel (1994), Connel (1990) and Ibrahim (2004).

Table (5): Chemical, physical and microbiology quality criteria of bissaria cakes substituted with different levels of plant flours (on wet wt basis).

Quality criteria	Control cake	Besseria cakes substituted with :								
		Fababean flour			Chickpea flour			Potatoes flour		
		10%	15%	20%	10%	15%	20%	10%	15%	20%
TVB-N mg/100g sample	22.02	20.5	19.6	17.5	21.5	21.0	18.6	14.5	13.8	11.7
TMA- N mg/100g ample	0.96	0.62	0.58	0.45	0.82	0.80	0.71	0.48	0.41	0.28
TBA mg Malonaldhyde/ kg	0.18	0.15	0.14	0.12	0.13	0.12	0.09	0.12	0.09	0.08
Cooking loos %	26.82	20.15	17.33	13.55	22.15	19.20	16.75	17.85	15.08	11.35
Cooking yield %	73.18	79.85	82.67	86.45	77.85	80.80	83.25	82.15	84.92	88.65
Total bacterial count (TBC)Log_{10} cfu/g sample	2.90	3.18	3.30	3.40	3.04	3.23	3.32	3.27	3.34	3.49
Spore forming bacteria (SFB)Log_{10}cfu/g sample	1.69	1.78	1.85	1.90	1.74	1.81	1.87	1.83	1.93	1.95
Yeast & Mould Log_{10} cfu/g sample	2.0	2.18	2.48	2.54	2.0	2.11	2.23	2.30	2.45	2.60

Regarding, physical quality properties of fried basseria cakes, the data of the same table illustrated that the cooking loss decreased and cooking yield increased by increasing plant flour levels. The cooking loss was higher in control sample (26.82) than other treatments (11.35 to 20.15).This may be attributed to denaturation of fish meat protein as explained by Abo-Baker (1987), El-Sharnouby and Shahat (1993). On the other hand, the lowest cooking yield was found in control sample (73.18%) in comparison with substituted cake with plant flours which ranged from (77.85 to 88.65%). This could be attributed to a high carbohydrate content in such fish meat substitute, in which the heat leads to the swelling of starch during cooking as reported by Williams and Zabik(1975).This result are agree with those observed by Mostafa *et al.* (2002) and Ibrahim (2004).

Concerning microbial aspects, the obtained data (table5) illustrated that total bacterial count (TBC), spores forming bacteria (SFB), yeast and mould counts were higher of cakes substituted with plant flours compared with control sample. These results could be attributed to the contamination that occurred during handling preparation of fish cakes or filling materials. In addition, the microbial load was increased in all investigated fish cake samples by increasing substitution levels of filling plant materials. The TBC was ranged from 3.04 to 3.49 log cfu/g fish cake sample contained filling materials, versus, 2.90 log cfu/g in the control fish cake samples. Similar trends were observed in (SFB), yeast and mould. The counts of bacteria in cake- potatoes were higher than other products. In general, based on these results, the microbial load status was varied according to the filling materials type and the substituted levels of them. These results are agreed with those reported by Akande ***et al*****.** **(**1991) and Ibrahim, (2004).

Sensory quality attributes of fried bissaria cakes:

The results shown in table (6) represented the average scores of the organoleptic properties i. e. color, odor, taste, texture and overall acceptability. Sensory evaluation results showed that there were are a significant difference between control and substituted cakes, whereas control recorded the lowest scores for the most properties, especially in color parameter. In addition, it could be observed that cakes substituted with 10% and 15% levels of fababean, chickpea and potatoes flours were had higher scores for all organoleptic properties compared with those containing 20%of them. Therefore, incorporation of that substitution material at 10% and 15% levels improved color, odor, taste, tenderness and overall acceptability characteristics of bissaria fish cakes. As general recommendation, it could be concluded that bissaria fish cakes contained 15% of fababean, chickpea and potatoes flours individually characterized with better sensory quality and more acceptability compared with control and other substitution levels and took the following order: chickpea-cake followed by potatoes-cake and fababean-cake. This concentration was in parallel with that given by El-Akel (1983) who found that incorporation of 15% soybean in bolti fish patties was suitable for this product, El-Magoli *et al.* (2006) give the same conclusion by addition of 15% defatted soybean flour, minced boiled potato and rice flour to silver carp fish patties. Thus, bissaria fish cakes substituted with 15% of fababean, chickpea and potatoes flours were chosen for amino acid analysis.

Table (6): Sensory evaluation for bissaria fish cakes substituted with different levels of plant flours.

Property	Control cake	Besseria cakes substituted with fababean flour				Control cake	Besseria cakes substituted with chickpea flour				Control cake	Besseria cakes substituted with Potatoes flour			
		10 %	15 %	20 %	L.S.D. at 5 %		10 %	15 %	20 %	L.S.D. at 5 %		10 %	15 %	20 %	L.S.D. at 5 %
Appearance	6.0	7.5	8.6	8.2	1.31	6.0	7.5	9.0	8.4	1.02	6.0	7.0	8.5	7.0	1.11
Odor	7.2	7.4	8.0	7.5	1.07	7.2	8.2	8.5	7.8	1.07	7.2	8.0	8.2	7.8	1.22
Taste	8.0	8.3	8.5	7.4	1.02	8.0	8.5	9.5	8.3	0.85	8.0	8.4	8.8	7.5	1.09
Texture	8.2	8.4	8.8	7.8	0.87	8.2	8.5	9.0	8.0	1.26	8.2	8.4	8.6	8.0	1.00
Overall acceptability	7.4	7.8	8.0	7.7	1.07	7.4	8.2	9.0	8.1	0.98	7.4	8.0	8.5	7.6	0.89

Excellent: 8.6 -10. ; Very good: 7.6 - 8.5. ; Good: 6.6 – 7.5. ; Accepted: 5.6 – 6.5.

Nutritional protein quality of bissaria fish cakes:

Data in Table (7) shows the indispensable amino acids (IAAs) composition (g /16g N) and nutritional protein quality value of fried the control bissaria fish cake and those substituted with the best level (15%) of plant flours. By comparing the total indispensable amino acids (TIAAs) of different fish cakes, it could be noticed that they were of high amount in control sample being, (41.15 g / 16 gm N). The other cake samples could be descending according their sum of TIAAs as follows: chickpea-cake (40.25 g / 16 gm N) followed by fababean-cake and latterly potatoes-cake (37.22 g / 16 gm N). Also, it could be noticed that all fish cake samples had much higher content (g / 16 gm N) of all indispensable amino acids (IAAs) than those of

(FAO/WHO/UNU, 1985) reference protein pattern. Thereby, amino acid score (AS) for all IAA was higher than (100) indicating that no deficient in any IAAs in the tested cake products. On the other hand, the first restricting IAAs (has the lowest AS) was histidine, while the second restricting one was amino acids containing sulpher (Meth.&Cyst.) for all fish cake samples. Nevertheless, the AS of these IAAs was higher than 100, confirming that all fish cakes, under investigation had a better nutritional protein quality.

In addition, the evaluation results of nutritional value, protein quality with regards the indispensable amino acids index (IAAsI), biological value (BV %) and protein efficient ratio (PER) of tested fish cakes were recorded in table (7). From the former table, it could be noticed that tested cake samples had better protein quality as indicated by higher of IAAsI, BV% and PER. Whereas, the chickpea-cake flour samples showed the high quality of protein followed by fababean-cake flour samples, while the lowest values of the same parameters were recorded for cake- potatoes flour samples.

Table (7): Nutritional protein quality evaluation of bissaria cake substituted with the best level (15%) of plant flours.

Indispensable amino acids (IAAs)	FAO/WHO UNU(1985) (g/16gmN)	Control	Bissaria cake substituted with the best level (15%) of :		
			Fababean flour	Chickpea flour	Potatoes flour
Isoleucine	1.3				
g/16g N		4.12	4.06	3.92	3.45
AS		316	312	302	265
Leucine	1.9				
g/16gN		7.05	6.66	6.97	6.32
AS		371	351	367	333
Lysine	1.6				
g/16gN		6.38	6.15	6.75	6.12
AS		398	384	422	383
therionine	0.9				
g/16gN		6.85	6.25	6.55	6.15
AS		761	694	728	683
Valine	1.3				
g/16gN		4.02	3.77	3.92	4.20
AS		309	290	302	323
Histidine ®	1.6				
g/16gN		2.52	2.62	2.75	2.45
AS		158	164	172	153
Methionine + Cystine®®	1.7				
g/16gN		3.15	2.32	2.59	2.15
AS		185	136	152	126
Phenylalanine + Tyrosine	1.9				
g/16gN		7.06	6.20	6.97	6.38
AS		372	326	367	336
TIAAs		41.15	38.20	40.25	37.22
I.A.As.I		79.50	73.46	77.69	71.56
B.V.%		74.92	68.34	72.95	65.90
PER		2.22	2.08	2.15	1.96

Tryptophan is not determined. **IAAs: Indispensable amino acids index.**
TIAAs: Total Indispensableamino acids. **B.V. %: Biological value.**
AS: Amino acid score. **BER: Protein efficient ratio.**
®: first restrict Indispensable amino acids (RA).
®®: Second restrict Indispensable amino acids (RA).

The results in table (8) also showed that the indispensable amino acids (IAAs) composition (as g/100gm sample) and the quantity of fried cake products should be consumed to cover the daily requirements (GDR) of the IAAs for adult man and satisfaction percentage of the daily requirements from all IAAs for adult man when consuming 100gm of the product (PS/100g %) in

relation to the USRDA, (1989). It could be noticed that 100g of all cake products contained a higher level of each IAAs than that recommended for the USRDA, with the exception of amino acids containing sulpher (Meth. & Cyst.).The obtained data of the same table evident that there were obvious variations between the GDR values of fish cake products as the result of the variation in their protein.

Table(8): Indispensable amino acids (IAAs) composition (g/100gm sample), calculated GDR and PS/100g sample of bissaria fish cake substituted with the best level (15%) of plant flours.

Indispensable amino acids (IAAs)	USRDA (1989)	Control	Bissaria cake substituted with the best level (15%) of :		
			Fababean Flour	Chickpea Flour	Potatoes Flour
Isoleucine	0.819				
g/100gm sample		1.00	0.77	0.86	0.60
GDR*		82	106	95	137
PS/100gm %**		122	94	105	73
Leucine	1.197				
g/100gm sample		1.71	1.27	1.53	1.11
GDR		70	94	78	108
PS/100gm %		143	106	128	93
Lysine	1.009				
g/100gm sample		1.54	1.17	1.48	1.07
GDR		65	86	68	94
PS/100gm %		154	116	147	106
Therionine	0.567				
g/100gm sample		1.66	1.19	1.43	1.08
GDR		34	48	40	53
PS/100gm %		294	208	250	189
Valine	0.819				
g/100gm sample		0.97	0.72	0.86	0.74
GDR		84	114	95	111
PS/100gm %		119	88	105	90
Methionine + Cystine ®	1.071				
g/100gm sample		0.76	0.44	0.57	0.38
GDR		141	243	188	282
PS/100gm %		71	41	53	35
Phenylalanine + Tyrosine	1.197				
g/100gm sample		1.71	1.18	4.53	1.12
GDR		70	101	78	107
PS/100gm %		143	99	128	93

GDR* = Gram consumed to cover the daily requirements of proteins and indispensable amino acids for adult man.

PS/100gm % =Percent satisfaction of protein and indispensable amino acids when consumed 100 gram from given product.**

®: Restricting indispensable amino acids (RA).

USRDA: United State Recommended Daily Allowances (gm) from indispensable amino acids for adult man.

Also, it could be noticed that the restricting indispensable amino acid (RA) was amino acids containing sulpher (Meth. & Cyst.) which having the highest GDR value (141-282g), and the lowest PS/100g % (35 to 71/100g %). Nevertheless, these results evident that the consumption of 100gm from any tested fish cakes samples was approximately enough and satisfaction of the daily requirements of all IAAs for adult man. Finally, it could be concluded

that all cake samples, under investigation, had high nutritional quality of protein. Therefore, the chickpea-cake flour samples showed better nutritional protein quality followed by fababean-cake flour and latterly potatoes-cake flour samples as indicated by higher value of IAAs, IAAsI, BV%, PER and PS/100g % with lower the GDR values.

Conclusion

The obtained results in the present investigation showed that bissaria fish can be utilized for the production of low coast fish cakes characterized with a good chemical, physical, healthy safe and nutritional quality criteria and acceptability with the addition of fababean, chickpea and potatoes flours to improve their quality attributes.

REFERENCES

Abo-Baker, T. M. (1987).Nutritional evaluation of sausage containing chickpea and fababeans as meat protein extenders. J. Food Chem., 23: 143.

Akande, G.H. (1991). Production of salted dried cakes from mechanically deboned mince from tuna framer. FAO Fish. Report No. 467 Supplement Processing of the FAO Export Consultation on Fish Technology in Africa Accra, Ghana, 22-55 October, 1991:150-155.

Akande, G.H; Towuru, E.T. and Ogbonna, C. (1991). Production, Acceptability and storage characteristics of spiced minced fish cakes. FAO Fish Report No. 467- Supplement Processing of the FAO Export Consultation on Fish Technology in Africa Accra, Ghana, 22-55 October 1991:163-168.

Alsmeyer, M.R.; Cunningham, A.E. and Happich, M. L. (1974). Equations predict PER for amino acid analysis. Food Techno. , July, PP: 34 – 40.

A.O.A.C., (2002).Official Method of analysis of the Association of Official Analytical Chemists. International, "17th" Edition Revision 2002, Washinton, Dc. U.S.A.

Atta, M.B.; Salama, A. and Ghazi A. (1993). Effect of different filling materials on organoleptic properties of fish cakes manufactured from common carp (*Cyprinus carpio*) fish flesh. Processing in International Conference on Future Aquatic Resources in Arabic Region.USDP & NIOF, Alex.6-8 Feb.1993.

Bonnel, A. D. (1994). Quality assurance in seafood processing. Chapter 5 quality assessment, P. 72. Academic press New York ,USA.

Connel, J.J. (1990). Control of Fish Quality Published by Fishing. News Books, a Division of Blackwell Scientific Publication, Cambridge-U.K.

El-Akel, A. T. (1983).The effect of processing and storage on fish quality. M. Sc. These, Food Sci. and Tech. Dep., Fac. of Agric., Cairo Univ., A.R.E.

El-Magoli, B.S.; Al-Nikeety, M.M.; AbdEl-Salam, M.A. and El-kordy, M.M. (2006). Quality indices of fish patties as affected by different extenders and storage at -18 ^{0}C. Egyptian J. of Nutrition Vol. XXI. No.2 (2006).

El-Sharnouby, G.A. and Shahat, M. (1993). Chemical, physical and sensory properties of beef burger as affected by substitution with chickpea flour. Al-Azhar J. Agric. Res. Vol.18, PP 193-204 December,1993.

FAO/WHO/UNU., (1985). Energy and Protein Requirements. Report of Joint FAO/WHO/UNU expert Consultation World Health Organization. Technical Report Ser. 724, WHO, Geneva.

FAO (1979). Manual of Food Quality Control.4. Microbiological Analysis Food and Agriculture Organization of the United Nation. Rome, 1414 PP.C 9-12. and D1-33

Ghazi, A.; Salama, A. and Atta, M.B.(1993).Chemical, physical and microbiology evaluation of fish cakes made of common carp (*Cyprinus carpio*) flesh. J Agric. Res.Tanta Univ., 19 (4). 1993.

Gould.G.W.and Hurst,A.(1969).The bacterial spores.Academic press,New York.

Ibrahim, S.M. (2004).Quality assessment of carp fish (*Cyprinus carpio* L.) cake. Minufiya J. Agric.Res., 29 (4): 913-924.

Maga, J. A. (1978). Amines in Foods. CRc Critical Reviews in Food Sic. and Nutrition, 373 - 403.

Millipore Co-Operative (1987). Liquid Chromatographic Analysis of Amino Acid in Foods using a Modification of the PICO.

Mostafa,M.M.; Abo-Taleb,M. and Ibrahim S. M. (2002). Evaluation of patties manufactured from tuna and catfish. Annals of Agric.Sci. Moshtohor, 40(3): 1595-1606, Egypt.

Nunes, M.L.; Batasta, I. and De-campos, R. M. (1992). Physical, chemical and sensory analysis of sardine stored in ice. J. Sci. Food Agric., 59: 37- 43.

Paedes-Lopez,O.; Harry, G. T. and Gonzalaza Costaneda, J. (1990). Sensory evaluation of tempeh produced by fermentation of common beans. J. Food Sci. 55 (1): 123-126.

Pearson, D., (1991). The Chemical Analysis of Food. Churchill, New York, London, PP: 374-410.

Oser, B. L. (1959).An Integrated Amino Acid Index for Predicting the Biological Value of Protein and Amino Acid Nutrition, ED. A. A. Albanese, Academic Press, New York.

Shen,L. (1996). Amperometric determination of fish freshness by a hypoxanthine biosensor. J. Sci. Food Agric., 70: 298 -302.

Smith, G. C.; Hyunil, J. and Cater,C.M.(1973).Efficiency of protein additives as emulation stabilizers in frank future. J. Food Sci., 38:349.

Steel, R.G. and Torii,J.H.(1980). Principles procedures of statistics(pp.120). Mc Graw – Hill, New York, USA.

USRDA, (1989).United State Recommended Dietary Allowances, Food Nutrition Board and National Res. Councils. National Academy of Science. Washington, D.

Williams,C.W.and Zabik,E.M.(1975).Quality characteristics of soy substituted ground beef,pork and turkey meat loves.J.Food Sci.,40: 502.

Woyewoda, A.D.; Show S. J.; Ke, P .J. and Burns, B.G. (1986). Recommended Laboratory Methods for assessment of fish quality. Canadian Technical Report of Fisheries and Aquatic Sci., No. 1448.

تقييم أقراص السمك المصنعة من سمك البساريا

شعبان عبد الحليم عبد المجيد الشريف
معمل تكنولوجيا تصنيع الأسماك - المعهد القومى لعلوم البحار والمصايد – مصر

أجرى هذا البحث لدراسة الاستفادة من أسماك البساريا الصغيرة الحجم والرخيصة الثمن والمرتفعة فى الجزء المأكول في تصنيع كيك السمك مع استخدام دقيق بعض المواد النباتية مثل دقيق الفول البلدي والحمص والبطاطس كمواد استبدال بلحم السمك بنسب ١٠،١٥،٢٠% لتقليل تكلفة الإنتاج وتحسين دلائل الجودة لتلك المنتجات. اشتملت الدراسة على تقييم دلائل الجودة الطبيعية والكيميائية والميكروبيولوجية والحسية والغذائية للمنتجات المصنعة .

ويمكن تلخيص النتائج التى تم الحصول عليها فيما يلى:- وجد أن الرطوبة والرماد والكربوهيدرات فى عينات الكيك المستبدل بدقيق المواد النباتية كانت اكبر من العينة المرجعية(الضابطة) وتزداد بزيادة مستوى الاستبدال وعلى العكس من ذلك فى محتوى البروتين والدهن والطاقة.كما لوحظ أن قيم القواعد النيتروجينية المتطايرة TVB-N والمركب الثلاثى ميثيل أمين نيتروجين TMA-N وحامض الثيوباربتيوريك TBA كانت اقل فى الكيك المستبدل مقارنة بالعينة الضابطة. كذلك وجد أن فاقد الطهى مرتفع فى العينة المرجعية (٢٦,٨٢%) بالمقارنة بعينات الكيك المستبدل (١١,٣٥-٢٠,١٥%) وعلى العكس من ذلك فإن ريع الطهى كان منخفضا فى العينة الضابطة (٧٣,١%) مقارنة بعينات الكيك المستبدل(٧٧,٨٥-٨٨,٦٥%). و كانت أعداد البكتيريا الكلية TBCوالبكتيريا المكونة للجراثيم SFB والخمائر والفطريات أعلى فى عينات الكيك المستبدل مقارنة بالعينة المقارنة وتزداد بزيادة مستوى الاستبدال إلا أنها كانت فى الحدود المسموح بها لمنتجات الأسماك. أظهرت نتائج التقييم الحسى أن عينات الكيك المستبدل بدقيق المواد النباتية كانت أكثر قبولا من المحكمين عن العينة الضابطة, وأن مستويات الاستبدال (١٥،١٠%) حسنت اللون والطعم والرائحة والقبول العام مقارنة بالعينة المقارنة,عينات الكيك المستبدل بدقيق المواد النباتية بمستوى ١٥% حصلت على أعلى تقييم حسى مقارنة بالعينة الضابطة وعينات مستويات الاستبدال الأخرى وتم ترتيبها حسب اعلى درجة تقييم حسى كالتالى: كيك البساريا المستبدلة بدقيق الحمص يتبعه كيك البساريا المستبدلة بدقيق البطاطس ثم كيك البساريا المستبدلة بدقيق الفول البلدى. العينات التى تم اختيارها كأحسن معاملة(١٥%) تم عمل تحليل احماض أمينية لها ووجد أن كيك البساريا المستبدلة بدقيق الحمص كانت أعلى فى جودة البروتين الغذائية يتبعه كيك البساريا المستبدلة بدقيق الفول البلدى ثم كيك البساريا المستبدلة بدقيق البطاطس وذلك بناء على القيم المرتفعة لكل من المجموع الكلى للأحماض الأمينية الأساسية(TIAA) , دليل الأحماض الأمينية الأساسية(IAAI), القيمة البيولوجية(BV%), معدل كفاءة البروتين (PER) , وانخفاض الاحتياجات اليومية (GDR) من المنتج والتى تعطى نسبة مرضية (PS/100g %) من البروتين. واشارت نتائج هذه الدراسة الى انه يمكن الاستفادة من سمك البساريا صغيرة الحجم فى أنتاج منتجات كيك السمك الرخيصة الثمن تتميزبصفات جودة وقبول حسى عالية بواسطة اضافة دقيق بعض المواد النباتية مثل دقيق الفول البلدى والحمص والبطاطس كمواد استبدال بلحم السمك بنسبة ١٥% .