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Production of New Burger from Small Size Shrimp and Carp Fish Meat

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ABSTRACT

This study aimed to utilize from small size shrimp meat and help in solving the problem of carp fish meat which is unpopular due to its high content of small bones in fish burger manufacture to produce a new product. Five formulas of fish burger from (small size shrimp and carp fish meat) were prepared. Formula1 (F1) (carp fish meat 60.0% ,bread crisp 10.0%, tomato juice 14.0%, eggs 7.0%, minced onion 6.0%, Sodium chloride 1.70%, spices 1% and cumin 0.3%, Formula2 (F2)=(minced carp fish meat 45.0% and minced small size Shrimp 15.0%), Formula3 (F3)=(minced carp fish meat 30.0% and minced small size Shrimp 30.0%), Formula 4(F4)=(minced carp fish meat 15.0% and minced small size Shrimp 45.0%) and Formula 5(F5)=(minced small size Shrimp 60.0%) and the other ingredients were added to all formulas with the same percentage. Chemical composition (moisture, protein, fat and ash),cholesterol content, Water Holding Capacity (WHC), plasticity, Shrinkage, Cooking loss, Thiobarbituric acid (TBA), total volatile nitrogen (TVN) and trimethylamine-nitrogen (TMA) and Sensory evaluation were analyzed at zero time and during storage at -18 ^{0}C for 3 months. The results found that F1 was the highest content of moisture and lipid followed by F2, F3, F4 and F5. While, F5 was the highest content of protein, ash and carbohydrates followed by F4, F3, F2 and F1, respectively at zero time and until the end time of storage. F5 was the highest level of cholesterol followed by F4, F3, F2 and F1, where recorded 43.39, 29.41, 21.27, 21.2 and 18.52 (mg/ 100g), respectively. All samples were accepted for TBA and TVN at zero time and until the end time of storage. F5 was the best value of WHC, plasticity, Shrinkage and Cooking loss (as quality properties) followed by F4, F3, F2 and F1 at zero time and until the end time of storage. All samples were accepted by sensory evaluation. Whereas, no significantly differences of color, taste, aroma, texture and overall acceptability between all the formulas.

Key words: shrimp, carp fish, Burger, small bones, fish burger manufacture.

Introduction

One of the important mince based product is fish burger. Fish burger is a very popular and tasty item in fast food industry. In recent years, the preference of the consumers has significantly directed towards the fast food consumption since there has been a rapid urbanization and an increase in working women population.

There are more than 20 main native carp species, contributing about 80 percent of the total freshwater fish production. Grass carp (*Ctenopharyngodon idella*) would serve as an adequate source of raw material for fish burger that may provide a good taste and nutrition to the young and outgoing people in cheaper rate (Haq *et al*., 2013). The presence of intramuscular bones in carps leads to low consumer preference for these species. Hence, there is a need to develop some convenience products from the meat of carps to enhance their consumer acceptability (Gopakumar, 1997).

Processing and value addition to carps is the need of the hour to sustain carp culture system and to make it more profitable. Seafood products, such as fish fingers, fish cutlets and fish burgers could supply a variety of healthy food to increase the per capita consumption (Elyasi *et al*., 2010).

Fish products are recommended for patients with high blood pressure, lipids and cholesterol. Among those products is fish burger. It is preferred by children and elderly people, over whole fish, due to presence of small spines in the carp fish. In addition, fish burger would help in solving the problem of carp fish which is unpopular due to its high content of small bones (Darweash, 1996). Fish flesh has some unique characteristics as having high protein content with balanced profile of amino acids, polyunsaturated and essential fatty acids with ω-3 series of fatty acids and low level of harmful cholesterol and saturated fat (Edwards and Kaewpaitoon 1981).

However, the use of small shrimps or broken shrimp meat for new products is still limited. Nowadays, burgers and battered products are very common, and are well-liked products in almost every country, especially European countries (Llorca *et al*., 2003). Therefore, the development of frozen battered shrimp burger should be

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a promising alternative to feature in the export market. The small size shrimp is considered underutilized seafood in Egypt. (Babitt, *et al.*, 1976) incorporated this shrimp in minced fish and found the improvement of acceptability and prolonging of shelf life stability by increasing the amount of shrimp in fish shrimp mix due to substances that exhibited antioxidant properties. The chemical composition of such small size shrimp which sold as breaded- chilled or breaded- frozen were; 59-70% moisture, 8-13% protein, 0.3-2.2% lipid, 14-32%carbohydrates, 0.4-1.2% salt and 5.3-16.7 mg/ 100gmTVN (Morimoto, *et al.,* 1981). Also, Ryu and Lee (1986) determined the nutritive value of some crustacean and concluded that small size shrimp revealed a great in vitro digestibility and a low contents of trypsin inhibitor.

Therefore, this work was conducted to use such underutilized small size shrimp and help in solving the problem of carp fish which is unpopular due to its high content of small bones in burger manufacture to produce a new product characterize with high nutritive value and low price for Egyptian consumers specially low and limited income.

Therefore, it is very important to develop new processing techniques of underutilized protein resources to make them useful and palatable food for human consumption.

Materials and Methods

Materials:

Small size shrimp (*Penaeus semisulactus*) and silver carp (*Hypophthalmichthys molitrix*) from the private sector shop in the local market at Giza, Egypt. On the arrival in the laboratory, the fish were scaled, eviscerated washed with tap water to remove blood and the black lining in the gut cavity. Afterward, head, skin and bones were removed with hands from all fish then minced to get rid of small spines via grinding.

Table 1: Ingredients of fish burger (control) were as follows:

Ingredients	Formula 1	Formula 2	Formula 3	Formula4	Formula 5
Carp fish flesh	60.00	45.00	30.00	15.00	-
Small size shrimp flesh	-	15.00	30.00	45.00	60.00
Bread crisp	10.00	10.00	10.00	10.00	10.00
Tomato juice	14.00	14.00	14.00	14.00	14.00
Eggs	7.00	7.00	7.00	7.00	7.00
Sodium chloride	1.70	1.70	1.70	1.70	1.70
Spices	1.00	1.00	1.00	1.00	1.00
Cumin	0.30	0.30	0.30	0.30	0.30
Onion	6.00	6.00	6.00	6.00	6.00

Ingredients of fish burger according to (Fouda et al., 2000).

Methods:

Processing of small size Shrimp and carp fish meat burger:

Minced carp fish meat divided into five formulas. Mix the ingredients of formula1 (F1) = (carp fish meat 60.0%, bread crisp 10.0%, tomato juice 14.0%, eggs 7.0%, minced onion 6.0%, Sodium chloride 1.70%, spices 1% and cumin 0.3%, Formula2 (F2)=(minced carp fish meat 45.0% and minced small size Shrimp 15.0%), Formula3 (F3)=(minced carp fish meat 30.0% and minced small size Shrimp 30.0%), Formula 4(F4)=(minced carp fish meat 15.0% and minced small size Shrimp 45.0%) and Formula 5(F5)=(minced small size Shrimp 60.0%) and the other ingredients were added to all formulas with the same percentage as in formula (F1). The formulas were separately then formed into discs of 100g, kept frozen at -18^{0}C for 3 months, samples were then taken for analysis.

Chemical analyses:

Chemical composition (moisture, protein, fat and ash) was determined according to A.O.A.C. (2000).Total carbohydrate was calculated by the difference as follows: Total carbohydrate = 100 – (moisture + protein + fat + ash). Cholesterol determination according to the methods of (Katsanidis and Addis,1999)

Chemical quality attributes:

Total volatile nitrogen (TVN) and trimethylamine-nitrogen (TMA-N) were determined according to the method published by Winton and Winton (1958). Thiobarbituric acid (TBA) value was determined as described by Egan *et al.,* (1981)

Physical properties:

Water Holding Capacity (WHC) and plasticity were measured during storage period according to the filter press method of Soloviev (1966). The cooking loss was determined according to Mahmoud (2008). Shrinkage was determined as the method described by AMSA, (1995).

Sensory evaluation:

Sensory evaluation of fish burger from small size Shrimp and carp fish meat was carried out according to Watts *et al*. (1989).

Statistical analysis:

Data were subjected to Analysis of Variance (ANOVA). Means comparison was performed using Duncan's test at the 5% level of probability as reported by Snedecor and Cochran (1994).

Results and Discussion

Data presented in table (2) showed the chemical composition of burger from small size shrimp and carp fish meat stored at – 18 ^{0}C for 3 months, it could be noticed that after direct manufacture at zero time the moisture and lipid content reduce while protein, ash and carbohydrates content increased with increasing the Add proportion of small size shrimp meat and reducing the Add proportion of carp fish meat in formula of burger.

Table 2: chemical composition of fish burger from small shrimp and carp fish meat stored at – 18 ^{0}C for 3 months

Formula number	Storage periods	Moisture %	Protein %	Fat %	Ash%	Carbohydrate%
F1	0	72.86	18.13	2.04	2.65	4.32
	1	72.60	17.90	2.06	2.86	4.58
	2	72.31	17.54	2.09	3.19	4.87
	3	71.82	17.20	2.13	3.40	5.45
F2	0	71.53	18.22	1.86	3.17	5.22
	1	71.29	18.09	1.89	3.32	5.41
	2	71.10	17.71	1.95	3.50	5.74
	3	70.03	17.32	1.99	3.65	7.01
F3	0	70.72	18.40	1.81	3.23	5.84
	1	70.39	18.23	1.92	3.51	5.95
	2	69.80	17.69	1.97	3.70	6.84
	3	69.35	17.49	1.98	3.95	7.23
F4	0	69.41	18.51	1.69	3.39	7.0
	1	69.19	18.38	1.73	3.63	7.07
	2	68.96	17.81	1.77	4.20	7.26
	3	68.36	17.63	1.81	4.52	7.68
F5	0	68.72	18.61	1.52	3.54	7.61
	1	68.41	18.45	1.62	3.82	7.67
	2	68.19	17.92	1.71	4.30	7.88
	3	67.56	17.81	1.75	4.63	8.25

So, it could be noticed that F1 was the highest content of moisture and lipid followed by F2, F3, F4 and F5. While, F5 was the highest content of protein, ash and carbohydrates followed by F4, F3, F2 and F1 respectively. This may be due to small size shrimp meat is higher of protein and lower of lipid content when compared with carp fish meat. Where, Teofil *et al*. (1969) pointed that chemical composition of shrimp meat was moisture 76.74%, fat 0.91%, ash 1.71 % and protein 22.07% and Puga-lópez *et al.,* (2013) found that chemical composition of shrimp meat was moisture 73.91%, fat 1.27%, ash 2.26 % and protein 20.04% . While Elyasi *et al.,* (2010) pointed that chemical composition of minced meat of carp fish was moisture 76.65%, fat 4.58%, ash 4.33% and protein 17.38 %. With advancement of frozen storage at – 18 ^{0}C for 3 months, the moisture and protein content decreased while the carbohydrate, fat and ash content increased in all samples tasted. Pandey & Kulkarni (2007) reported the decrease in the moisture content in grass carp cutlets and fish fingers during the frozen storage at -18^{0}C for 6 months. In addition, Mahmoud (2008) found that the moisture and protein content decreased and the carbohydrate, fat and ash content increased in carp fish kobebah with squid and with shrimp during storage at - 18 ºC for 6 month. Mahmoudzadeh *et al.* (2010) reported the initial fat content of brush tooth lizard fish burger as 5.45% during the frozen storage for 5 months. Ninan *et al.* (2010) reported the initial fat content of tilapia fish cutlet as 2.14% during the frozen storage for 21 weeks. Lakshminatha *et al*. (1992) also found the increase in the ash content during the frozen storage of fish fingers made from croakers during the frozen storage at -20^{0}C for 22 weeks. Hassaballa *et al*. (2009) observed the initial ash content of catfish fish burger as 1.70 during the frozen storage.

Table (3) pointed the cholesterol content in fish burger from small size shrimp and carp fish meat, it could be concluded that F5 was the highest level of cholesterol followed by F4, F3, F2 and F1, where recorded 43.39, 29.41, 21.27, 21.2 and 18.52 (mg/ 100g) respectively. This may be due to the cholesterol content of shrimp meat was higher (173 mg/ 100g), while the cholesterol content of carp fish meat was 73.73 (mg/ 100g) according to Syama *et al*. (2013) and Ljubojevic *et al.* (2013). Cholesterol level increased with increasing the Add proportion of small size shrimp meat and reducing the Add proportion of carp fish meat in formula of the fish burger so F1 was the lowest level of cholesterol followed by F2, F3, F4 and F5 respectively. Fresh and clean shrimps can be served either cooked or uncooked with sauce. From a nutritional standpoint, shrimps are high in protein, low in saturated fat and calories, and have a neutral flavor. Due to these characteristics, shrimps form a natural additive in salads, pastas, curry, soups and stir-fried dishes. Shrimps have also been identified as a rich source of vitamin B12, selenium, ω-3 highly unsaturated fatty acids (HUFA) and astaxanthin, a potent natural antioxidant. Despite the several nutritional parameters of shrimp based on which it can be considered as a healthy food, there is reluctance among dieticians and health professionals as well as consumers because of its relatively higher cholesterol. A clinical study showed that moderate shrimp consumption in normolipidemic subjects will not adversely affect the overall lipoprotein profile and can be included in 'heart healthy' nutritional guidelines (Syama *et al.,* 2013). Therefore, this work was conducted to production a new fish products included on nutritive value of shrimp meat and reducing the risk of consumption of level cholesterol in shrimp meat.

Table 3: Cholesterol content of fish burger from small shrimp and carp fish meat

Formulas	Cholesterol content (mg/100g)
F1	18.52
F2	21.2
F3	21.27
F4	29.41
F5	43.39

From the obtained data presented in Table (4) it could be reported that at zero time after directly manufacture for fish burger from small size shrimp and carp fish meat the value of TVN and TMA increased with increasing the Add proportion of small size shrimp meat and reducing the Add proportion of carp fish meat in formula of burger.

So, it could be noticed that F1 was the lowest value of TVN and TMA followed by F2, F3, F4 and F5. This may be due to small size shrimp meat is higher of protein and lower of lipid content when compared with carp fish meat. TVN and TMA increased continuously as time of storage increased. This was in accordance with findings of Moini and Farzanfar (2005) and El-Kordy (2006) who reported that, during frozen storage, TVN progressively increased. This may explained by active of enzymes or total bacterial count and proteolytic bacteria, Mahmoud (2008). At any time of storage that F1 was the lowest value of TVN and TMA followed by F2, F3, F4 and F5.

According to Egyptian standard (1991) frozen fish products should not be contained TVN more than 30 mg / 100gm (w.w). It is clear that this level was not exceeded as all samples had less TVN than the allowance.

From the same table (4), it could noticed that that at zero time after directly manufacture for fish burger from small size shrimp and carp fish meat the value of TBA reduced with increasing the Add proportion of small shrimp meat and reducing the Add proportion of carp fish meat in formula of the fish burger . F5 was the lowest value of TBA followed by F4, F3, F2 and F1 respectively at zero time of storage and at any time of

storage. This may be due to small size shrimp meat is lower of lipid content when compared with carp fish meat. The TBA values increased progressively as the time of storage increased in all samples. This may be attributed to fat content as table (2), where, F1 was the highest content of fat followed by F2, F3, F4 and F5. This may be led to increase the active of enzymes, lipolytic bacteria and psychrophilic bacteria of fish burger from small shrimp and carp fish meat ,Mahmoud (2008).

According to Egyptian standard (1991) frozen fish products should not be contained TBA more than 4.50 mg malonaldehyde / kg sample. It is clear that this level was not reached, as after 3 months of frozen storage, TBA values of formulas fish burger from small shrimp and carp fish meat (F1,F2,F3,F4 and F5) were 0.930, 0.870 , 0.850, 0.810 and 0.770 mg malonaldehyde / kg (w.w) respectively. These results were in agreement with the findings of Tokur *et al*. (2006) and Sanchez- Alonso *et al*. (2007).

Table 4: TBA, TVN and TMA of fish burger from small shrimp and carp fish meat stored at – 18 ^{0}C for 3 months

Formula number	Storage periods	TBA	TVN	TMA
F1	0	0.30	4.30	0.53
	1	0.61	5.81	1.09
	2	0.82	7.22	1.43
	3	0.93	8.59	1.99
F2	0	0.25	4.81	0.67
	1	0.55	6.26	1.28
	2	0.73	7.89	1.73
	3	0.87	9.03	2.19
F3	0	0.20	5.21	0.72
	1	0.51	6.53	1.39
	2	0.68	8.04	1.92
	3	0.85	9.88	2.38
F4	0	0.15	5.82	0.81
	1	0.40	7.66	1.51
	2	0.62	9.21	2.20
	3	0.81	10.34	2.64
F5	0	0.13	6.35	0.92
	1	0.36	8.32	1.72
	2	0.50	9.95	2.39
	3	0.77	11.83	2.83

T.V.N. : Total volatile nitrogen (mg/100mg), T.B.A. : Thiobarbituric acid (mg malonaldehyde/kg) ,T.M.A.: Trimethyl amine (mg/100mg)

The obtained results were shown in Table (5) pointed that the WHC, plasticity, Shrinkage and Cooking of fish burger from small size shrimp and carp fish meat stored at – 18 0C for 3 months. WHC is defined as water holding capacity and not easily lost. The indicator of the quality of the meat products. There is a direct relationship between WHC, plasticity and Shrinkage and an inverse relationship with the cooking loss. From this results it could be noticed that at zero time after directly manufacture for fish burger from small shrimp and carp fish meat the WHC, plasticity, Shrinkage (as quality) improved with increasing the Add proportion of small size shrimp meat and reducing the Add proportion of carp fish meat in formula of burger. So, it could be noticed that F5 was the best value of WHC, plasticity, Shrinkage and Cooking loss (as quality properties) followed by F4, F3, F2 and F1. This may be due to small size shrimp meat is higher of protein and lower of lipid content when compared with carp fish meat. It is known that fat is a hydrophobic substance (water repelling and do not blend with water with emulsifying). During storage, it could be found that, WHC, plasticity, Shrinkage and Cooking loss (as quality properties) decreased with increasing of storage time for all samples.

At any given time of storage (including zero time), it could be noticed that F5 was the best value of WHC, plasticity, Shrinkage and Cooking loss (as quality properties) followed by F4, F3, F2 and F1. This may be due to F5 had highest of protein and the lowest of lipid content followed by F4, F3, F2 and F1 at any given time of storage (including zero time). With advancement of frozen storage, the WHC, plasticity, Shrinkage and Cooking loss (as quality properties) were progressively decreased as a result of the development of protein denaturation upon storage (Fouda *et al.,* 2000, El-Kordy, 2006 and Soumia *et al.,* 2012).

The obtained results in Table (6) show the means scores for color, taste, aroma, texture and overall acceptability of fish burger from small size shrimp and carp fish meat immediately after processing (zero time), it could be noticed that no significantly differences of color, taste, aroma, texture and overall acceptability of fish burger from small size shrimp and carp fish meat for different formulas (F1, F2, F3, F4 and F5). Nevertheless, formula(F4) from fish burger from small size shrimp and carp fish meat had the highest score (7.65) of color followed by F5, F3, F2 and F1. While, F3 had the highest score (8.20) of texture followed by F2, F4, F5 and F1. This is in addition to the formula (F3) and formula (F2) were the best score (7.6) of taste followed by F5, F1 and F4 were recorded 7.6, 7.4 and 7.3 respectively. It could be noticed that formula (F3) had the highest score of aroma (8.0) and overall acceptability (7.84) followed by F2, F5, F4 and F1.

Table 5: Physical properties of fish burger from small shrimp and carp fish meat stored at – 18 ^{0}C for 3 months

Formula number	Storage periods	WHC (Cm^2/0.3 g)	plasticity	Shrinkage%	Cooking loss%
F1	0	1.9	2.86	29.30	26.09
	1	2.05	2.69	30.73	27.85
	2	2.56	2.560	31.79	29.35
	3	2.83	2.48	32.89	30.50
F2	0	1.70	3.19	28.52	23.67
	1	1.90	3.02	28.93	24.91
	2	2.18	2.90	29.87	26.89
	3	2.51	2.81	31.82	27.92
F3	0	0.80	3.30	27.95	22.45
	1	1.03	3.16	28.23	24.52
	2	1.59	2.95	29.70	25.89
	3	1.79	2.72	30.55	26.51
F4	0	0.70	3.83	27.29	20.75
	1	1.01	3.60	27.50	22.59
	2	1.36	3.41	28.81	23.48
	3	1.65	3.18	29.60	24.99
F5	0	0.30	3.90	27.00	19.39
	1	0.60	3.82	27.39	21.80
	2	0.90	3.56	28.01	22.95
	3	1.51	2.92	29.48	23.42

Water holding capacity = W.H.C. (Cm^2/0.3 g), Plasticity = (Cm^2/0.3 g)

Table 6: Sensory evaluation of fish burger from small shrimp and carp fish meat immediately after processing (zero time)

Properties / Formulas	Color	Aroma	Taste	Texture	Overall acceptability
F1	7.5 a ±1.2	7.35a±1.1	7.4 a±1.1	7.4 a±0.4	7.29 a±1.0
F2	7.1 a ±1.1	7.95a±1.15	7.6 a±1.2	8.0 a±0.5	7.66 a±1.1
F3	7.55 a ±1.2	8.0a±1.2	7.6 a±1.1	8.20 a±0.5	7.94 a±0.9
F4	7.65 a ±1.2	7.55a±1.15	7.30 a±1.2	7.80 a±0.6	7.58 a±1.0
F5	7. 60 a ±1.1	7.65a±1.15	7.60 a±1.0	7.70 a±0.5	7.64 a±0.6
LSD	2.403	2.092	2.042	0.917	1.702

The letter a, b, c, d, e and f mean with in a raw followed by the same letter are non-significantly different (P≤ 0.05).

Conclusion:

It could be concluded from this study it can be utilize from small size shrimp meat and carp fish meat to produce fish burger as a new product characterized with high nutritive value and low price for Egyptian consumers specially low and limited income and help in solving the problem of carp fish, which is unpopular due to its high content of small bones and reducing the risk of consumption of high level cholesterol in shrimp meat if it was consumed alone. Specially, the results indicated that no significantly differences of color, taste, aroma, texture and overall acceptability of fish burger from small size shrimp and carp fish meat for the different formulas.

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