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Effect of Recipes Ingredients on Quality Attributes of Carp Burgers

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ABSTRACT

This work was planned to investigate the effect of recipes ingredients on Common carp (*Cyprinus carpio*) burgers quality. The minced carp was mixed with recommended recipe ingredients (A) and other one was mixed with Spysi recipe ingredients (B). After that, two batches were formed by burgers machine. Results showed that recipe (B) improved water holding ability in raw burgers samples as compared with other one (A). Changes in chemical composition exception protein content of microwave cooked burgers (A) and (B) were similar. Raw burgers with recipe (B) had high values of total volatile basic nitrogen (TVB-N) (21.7 mg\100g ww); trimethylamine nitrogen (TMA-N) (2.33mg\100g) and low value of thiobarbituric acid (TBA). In addition, Cd level did not detectable in raw fish flesh and its products with different recipes. Raw burgers with recipe (B) had high levels of minerals (Fe, Zn, and Cu) than that with recipe (A). Frying increased levels of Fe, Cu and Mn in burgers with recipe (A) as compared with recipes (B). On the other hand, two recipes led to increase in microbial load in raw burgers. Total plate count (TPC) (49×10^3cfu\g), thermophilic (50 cfu\g), yeasts and molds (20 cfu\g) were higher in raw burgers with recipe (A) than other one (B) however, enterobacteriaceae count was undetectable. In addition to, both recipes (A and B) improved sensory properties of cooked burgers in particular odor property in case of burgers with recipe (B). In conclusion, this work recommends that ingredients of recipes used had clearly affect quality properties of burgers. Also, recipe (B) had a high ability of water holding capacity, nutritive value and improved sensory characteristics especially odor property of burgers manufactured from common carp compared with recipe (A).

Keywords: fish burger, quality properties, heavy metals, cooking methods.
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INTRODUCTION

Fish is a good source of protein and can be used as an alternative to meat (lamb, pork and chicken), this may be due to fish low cholesterol, optimal protein amount, high digestibility and polyunsaturated fatty acids such as omega-3, essential amino acids and other elements necessary for the maintenance of healthy body (Boran and Kose, 2007 and Adebayo-Tayo *et al.,* 2012). However, fish is a highly perishable commodity that undergoes spoilage as soon as it harvested. Consequently, fish processing has a special concerning in fishing and aquaculture industries. The processing and preservation of fresh fish are of utmost importance since fish is highly susceptible to deterioration immediately after harvest and also to prevent economic losses (Okonta and Ekelemu, 2005; Gupta and Gupta, 2006). Also, the advantage of preservation is to reduce wastage of fresh products, extends the shelf life, develops value added products and to provide convenient preferable forms (Meenakshi *et al.,* 2010). Carps, as freshwater fish species, has been one of the most widely cultured species all over the world due to its fast growth rate, easy cultivation and high feed efficiency ratio. However, carps having intramuscular bones have low consumer preference and hence limited market (Gelman and Benjamin, 1988; Yongkong *et al.,* 2002). Many reports have focused on alternative products from carp mince such as fish burgers, balls, frankfurters and other sausages (Yanar and Fenercioglu, 1999; Siddaiah *et al.,* 2001). Large size silver carp fish for the production of fast fishery products such as fingers, patties, kofta and chips could be utilized. These products had a high nutritional quality as well as good acceptability (El-Sherif and Ibrahim, 2012). In addition, the nutritive value of the investigated products was based on percent of minced fish formula. Therefore, this work was planned to investigate the effect of recipes ingredients (recommended recipe, A) and (Spysi recipe, B) on burgers quality made from common carp (*Cyprinus carpio*).

MATERIALS AND METHODS

Materials:

Fish samples: Common carp fish (*Cyprinus carpio*) samples (average weight and length were 3.70 kg and 57 cm, respectively) were purchased from Elserw village, Dammetta Governorate during May 2015.

Methods:

Preparation of recipe ingredients: All ingredients used in this study were purchased from local market (Ibrahim *et al.,* 2008). Two recipes ingredients were investigated as follows: recommended recipe (A) composed 9% palm oil, 8% starch, 2.3% Sodium chloride, 2.5% onion, 0.5% garlic, 0.3% Sod. polyphosphate, 0.4% Sod. bicarbonate and 2% spices mixture (42% black pepper, 23% cumin, 18% all spices, 5% coriander, 5% ginger, 2% clove, 2% cardamom, 2% cubeb and 1% red pepper) with 75% fish mince were mixed (Chndrasekhar and Mohite, 1978) and recipe (B) namely prepared Spysi vegetar (9%) with 91% fish mince were mixed.

Technological processes: Fish samples were transported using ice box to Fish Technology and Processing Lab., Elkanater Elkhairia Station for Fish Research, National Institute of Oceanography and Fisheries. Then, they were carefully washed with tap water, filleted, carefully washed again, drained, minced using electric meat mincer with a pore size 3 mm and divided into two batches; first one was mixed with recipe ingredients (A) and other one was mixed with recipe ingredients (B). After that, two batches were

formed by burgers machine (50 g unit), cellophane packed in foam dishes, stored at -18°C and analysed.

Cooking methods: Two cooking methods; deep frying in corn oil using electrical fryer at 220°C for 3-5 min (Weber *et al.,* 2008) and microwave cooking for 10 min using SAMSUNG oven (Model no. M1932, 28 L., Korea) were applied.

Analytical methods: Chemical composition of raw fish and burgers; moisture, crude protein (TN × 6.25), lipid content, ash and carbohydrate content were analyzed according to the methods described in AOAC (2000). Some quality attributes such as total volatile basic nitrogen (TVBN) (Pearson, 1976), trimethylamine nitrogen (TMAN) (AOAC, 2000), thiobarbituric acid (TBA) (Tarladgis *et al.,* 1960) and pH value (Egbert *et al.,* 1992) were determined. Microbial examination; total plate count (TPC), enterobacterease bacteria, thermophilic bacteria, yeast and molds counts were determined as reported by (Oxoid, 1982). Sensory properties; color, odor, texture, taste and overall acceptability of cooked burgers were evaluated. Minerals and heavy metals; Cd, Mn, Cu, Zn and Fe were determined as reported by APHA (2005).

Statistical analysis: The obtained results (n=3) were statistically analyzed using SPSS (Ver. 16) and were expressed as mean ± SE.

RESULTS AND DISCUSSION

Chemical composition

Table (1) shows the chemical composition (ww) of raw common carp flesh and burgers with recipes A and B. Raw fish flesh composed 80.39% moisture, 16.07% crude protein, 2.68% lipid, 0.60% ash and 0.27% free nitrogen extract. These results are in agreement, exception moisture content, with those reported by Ćirković *et al.,* (2012); Abdelaal *et al.,* (2014) and Elsayed (2016), who found that the ranges (ww) were 72.07 – 75.50% moisture, 15.20 – 20.50% protein, 2.99 – 9.26% lipid, 0.79 – 1.60% and 0.01 – 4.29% carbohydrates content of common carp flesh. In addition, water content is greatly effective on the quality and shelf life of food because it encourages microbial growth as mentioned by Nurjanah *et al.,* (2015). Concerning the effect of recipes ingredients, raw burgers A and B samples contained 60.70% and 64.46% moisture, 22.92% and 22.10% protein, 11.05% and 10.28%, 2.63% and 2.07% ash and 2.70% and 1.09% carbohydrates content, respectively. Weber *et al.,* (2008) reported that the high level in the ash content could be due to the decrease in moisture as a result to frying process. These results are in accordance with those reported by Talab (2014) and Elsayed (2016).

Table 1. Chemical composition (ww) of raw common carp, raw and cooked burgers with recipes A and B.

Constituent (%)	Raw Fish	Carp burgers treated with recipes: (A)			(B)		
		Raw	Fried	Microwave	Raw	Fried	Microwave
Moisture	80.39±0.12	60.70±1.23	52.70±0.67	59.90±0.47	64.46±1.11	56.88±0.51	58.93±0.48
Crude Protein	16.07±0.247	22.92±0.12	26.37±0.24	24.42±0.31	22.10±0.12	27.34±0.08	27.13±0.13
Lipid	2.68±0.375	11.05±0.08	17.25±0.12	11.37±0.17	10.28±0.21	12.87±0.12	10.45±0.07
Ash	0.60±0.135	2.63±0.02	2.39±0	2.29±0.17	2.07±0.06	1.56±0.06	2.38±0.1
Carbohydrate	0.27±0.085	2.70±0.07	1.29±0.22	2.02±0.14	1.09±0.03	1.35±0	1.11±0.23

Recipe A: Recommended recipe. Recipe B: Spysi vegetar

With regard to the effect of cooking methods on the chemical composition of burgers treated with recipes A and B, it could be found that moisture content loss in fried products A was higher than that B. This reduction occurred in moisture content in cooked products may be due to water evaporation as affected by thermal process and changing in other constituents. Also, frying process increased lipid content which is referring to adsorption from frying oil medium. On the other hand, in case of microwave cooked burgers, it was found that reduction rate in moisture was lower than that of fried products and vice versa was found in protein content. The decrement in moisture content is due to the effect of heating during cooking . These results are confirmed by these of Weber *et al.,* (2008); El-Sherif and Ibrahim (2012); Talab (2014) and Elsayed (2016).

Quality attributes:

Quality criteria (ww) of raw common carp flesh and burgers treated with recipes A and B are presented in Table (2). Raw fish flesh contained 14.70 mg\100 g samples as TVB-N, 1.71 mg\100 g samples as TMA-N, 1.49 mgMAD\kg samples as TBA indicator and 6.32 pH value. Our results are within those findings by Ibrahim (2004[a,b]); Fan *et al.,* (2009); Khidhir (2011); Zakipour and Divband (2012); Elsayed (2016) who reported that the ranges (ww) were 7.73 – 16.5 mg TVB-N\100 g sample, 0.83 – 5.62 mg TMA-N\100 g sample, 0.06 – 5.29 mg MAD\kg sample as TBA index of raw carp flesh. Concerning the effect of recipes ingredients on quality criteria, raw burgers A and B samples contained 20.00 and 21.70 mg TVB-N \100 g sample, 1.74 and 2.33 mg TMA-N \100 g sample, 1.29 and 1.19 mg MAD\kg sample as TBA index and 6.40 and 6.37 pH values, respectively. The ingredients of recipes B increased in TVN, TMA and pH values compared with recipes A, this is due to a high percent of fish mince in case burgers (B) . These results are in accordance with those reported by Mostafa *et al.* (2002).

Table 2. Quality attributes (ww) of raw common carp, raw and cooked burgers with recipes A and B.

Criterion	Raw fish	Carp burgers treated with recipes: (A)			(B)		
		Raw	Fried	Microwave	Raw	Fried	Microwave
TVB-N (mg/100g)	14.70±0.70	20.00±0.80	22.12±0.76	23.10±0.70	21.70±0.70	22.20±4.20	23.70±0.41
TMA-N (mg/100g)	1.71±0.27	1.74±0.03	2.11±0.05	1.41±0.52	2.33±0.15	1.97±0.28	1.69±0.66
TBA (mg MAD/kg)	1.49±0.11	1.29±0.15	1.64±0.20	1.81±0.02	1.19±0.04	1.27±0.04	1.42±0.01
pH value	6.33±0.02	6.40±0.01	6.38±0.00	6.49±0.04	6.37±0.01	6.42±0.00	6.00±0.01

Recipe A: Recommended recipe. Recipe B: Spysi vegetar.

With regard to the effect of cooking methods on some quality criteria of fried burgers treated with recipes A and B, it could be found that 22.12 and 22.20 mg TVB-N \100 g sample, 2.11 and 1.97 mg TMA-N \100 g sample, 1.64 and 1.27 mg MAD\kg sample as TBA index and 6.38 and 6.42 pH values, respectively. On the other side, the corresponding values in microwave cooked products were 23.10 and 23.70 mg TVB-N \100 g sample, 1.41 and 1.69 mg TMA-N \100 g sample, 1.81 and 1.42 mg MAD\kg sample as TBA index and 6.49 and 6.00 pH values, respectively. Zaitsev *et al.*, (1969) mentioned that during frying, the proteins coagulate and moisture is released, but with a further rise in temperature, protein hydrolyze and become denaturized with a tendency of increasing the content of nitrogenous extractive, ammonia, and hydrogen sulfide in fish flesh. Also, increment in MDA may be due to the oxidation of polyunsaturated fatty acids coming from the used oil (Saghir *et al*., 2005 and Serrano *et al*., 2006). Besides, the increase in pH values might be referring to the formation of some basic compounds due to of amino acids degradation (Ruiz-Capillas and Moral, 2001). In general, cooking methods in particular microwave method increased the most quality values. Our results are in agreement with those reported Ibrahim (2004[a]); Ibrahim *et al.,* (2008); Talab (2014); Elsayed (2016) and Mahmoud *et al.* (2016).

Micro minerals and heavy metals levels

Table (3) demonstrates heavy metals levels (ppm ww) of raw common carp flesh, raw and cooked burgers with recipes A and B. some micro minerals (Fe, Zn, Cu, and Mn) and heavy metal (Cd) were determined in raw fish flesh, raw and cooked burgers. Firstly Cd metal was not detectable in all samples investigated; this means fish flesh is considered as safe for human consumption. Raw fish flesh (ww) contained 0.27 ppm Fe, 0.15 ppm Zn, 0.09 ppm Cu and 0.03 ppm Mn. The present concentrations were considered under the maximum permissible limits according to Egyptian Standard Specifications (ESS, 2000) and FAO (2009).

Effect of recipes ingredients, raw burgers with recipe A contained 0.047ppm Fe, 0.040 ppm Zn, 0.003 ppm Cu and 0.008 ppm Mn. On the other hand, raw burgers with recipe B contained 0.055 ppm Fe, 0.050 ppm Zn, 0.011ppm Cu and 0.008 ppm Mn. Thereby, raw burgers with recipe B had high levels of minerals than that with that recipe A, this may be due to difference in ingredients used and a high percent of fish mince in case burgers (B). Concerning the effect of cooking methods on minerals levels, it could be found that frying increased levels of Fe, Cu and Mn in burgers with recipe A compared with that recipes B. Besides, Zn level did not influence by frying conditions in all burgers studied. With regard to the effect of microwave cooking, it could be found that all minerals increased exception Fe in burgers with recipe A while they were fluctuated in burgers with recipe B. Our results are in agreement with those reported by Abd-Elsalam (2013).

Table 3. Micro minerals and heavy metals levels (ppm, ww) of raw common carp, raw and cooked burgers with recipes A and B.

Element	Raw fish	Carp burgers with recipes; (A) Raw	(A) Fried	(A) Microwave	(B) Raw	(B) Fried	(B) Microwave
Cd	*UD	UD	UD	UD	UD	UD	UD
Mn	0.03±0.001	0.008±0.002	0.011±0.001	0.009±0.003	0.008±0.001	0.008±0.002	0.007±0
Cu	0.09±0.006	0.003±0.000	0.009±0.002	0.010±0.001	0.011±0.004	0.004±0.000	0.009±0.002
Zn	0.15±0.001	0.040±0.004	0.040±0.001	0.043±0.008	0.050±0.002	0.048±0.002	0.042±0.001
Fe	0.27±0.006	0.047±0.004	0.053±0.007	0.044±0.00	0.055±0.003	0.045±0.002	0.065±0.003

Recipe A: Recommended recipe. Recipe B: Spysi vegetar. *UD: Undetectable.

Microbial aspects

The microbial aspects of raw common carp flesh, raw and cooked burgers with recipes A and B showed in Table (4). Raw fish flesh contaminated with 41×10^3 cfu\g sample as TPC, 4 × 10 cfu\g thermophilic bacterial count and 1×10^3 cfu\g yeasts and molds counts. TPC agrees with those showed that it ranged from 2.3 to 5 log cfu\g sample of common carp (Ibrahim, 2004[b] and Elsayed, 2016). Effect of recipes ingredients, raw burgers with recipes A and B contaminated with 49×10^3 cfu\g sample as TPC, 6×10 cfu\g thermophilic bacterial count, 2×10^3 cfu\g yeasts and molds counts. The corresponding counts in raw burgers with recipes B were 47×10^3, 5×10 cfu\g, 1×10^3 cfu\g sample, respectively. Enterobacteriaceae count was not detectable either in raw, as well as cooked products. Similar results are findings by Talab (2014); Elsayed, 2016 and Mahmoud *et al.* (2016).

Table 4. Microbial aspects of raw common carp, raw and cooked burgers with recipes A and B.

Criterion	Raw fish	Carp burgers with recipes: (A) Raw	(A) Fried	(A) Microwave	(B) Raw	(B) Fried	(B) Microwave
TPC (countx10^3 cfu/g)	41.00±1.0	49.00±2.00	8.00±1.00	9.00±2.00	47.00±3.00	7.00±4.20	9.00±0.41
Thermophilic (countx10 cfu/g)	4.00±0.5	6.00±1.00	3.00±0.42	5.00±1.00	5.00±0.50	1.00±0.28	2.00±0.66
Enterobacteriaceae (countx10 cfu/g)	*UD	UD	UD	UD	UD	UD	UD
Yeasts and molds (countx10^3 cfu/g)	1.00±0.5	2.00±0.45	UD	UD	1.00±0.30	UD	UD

Recipe A: Recommended recipe. Recipe B: Spysi vegetar. *UD: Undetectable.

Cooking processes especially frying had greatly affected microbial counts compared with microwave cooking. In addition, counts of yeasts and molds were not detectable in both burgers with recipes A and B.

Therefore, microbial load in fish burgers are depending mainly on and recipes ingredients and cooking method applied. TPC was decreased of cooked fillets with edible coatings is due to deep frying (Ammar and Korish, 2009 and Khanipour *et al.*, 2014). These results are in accordance with those reported by Ibrahim *et al.* (2008); Talab (2014) and Elsayed (2016).

Sensory properties

Sensory properties of cooked common carp burgers with recipes A and B are shown in Table (5). Effect of recipes ingredients in this work showed that scores by some staff in the National Institute of Oceanography and Fisheries (NIOF) were similar in the color, texture and taste properties of fried products with recipes A and B while the odor property in case of fried burgers with recipes B was higher than other one (A). Concerning microwave cooked burgers products, similar trend was observed in all sensory tests but color property in recipes A was better than that with recipes B and vice versa was found in case of taste property. These variations in sensory tests are depending mainly upon ingredients of recipes used and type of cooking methods. Our results of cooked fishery products are in agreement with those findings by El-Sherif and Ibrahim (2012); Talab (2014) and Elsayed (2016).

Table 5. Sensory properties of cooked common carp burgers with recipes A and B.

Property	Carp burgers with recipes; (A)		(B)	
	Fried	Microwave	Fried	Microwave
Color	9.5±0.32	9.3±0.93	9.5±0.40	9.0±0.80
Texture	10.0±0.54	9.5±0.87	10.0±0.51	9.5±0.77
Odor	9.0±0.51	8.9±0.51	9.6±0.41	9.0±0.55
Taste	10.0±0.93	8.7±0.80	10.0±1.01	9.0±0.65
Overall acceptability	9.6±0.40	9.1±1.02	9.8±0.31	9.1±0.98

Recipe A: Recommended recipe. Recipe B: Spysi vegetar.

CONCLUSION

Finally it could be concluded that ingredients of recipes used had clearly affect quality properties of burgers. Also, recipe (B) had a high water holding capacity and improved sensory characteristics of burgers, especially odor property, manufactured from common carp compared with recipe (A).

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تاثير مكونات الخلطات الغذائية علي جودة بيرجر سمك المبروك العادى

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[١] قسم الأقتصاد المنزلي - كلية التربية- جامعة بنها

[٢] معمل تكنولوجيا تصنيع المنتجات البحرية- المعهد القومي لعلوم البحاروالمصايد

يهدف هذا البحث الي دراسة تأثير مكونات الخلطات الغذائية علي جودة بيرجر سمك المبروك العادى .تم فرم شرائح سمك المبروك وخلطها بنوعين من الخلطات. الخلطة الشائعة (أ)، والخلطة اسبايسي (ب) ثم تشكيلهما فى صورة بيرجر. تم دراسة تاثيربعض طرق الطهى (القلى في زيت عميق والطهي فى فرن الميكروويف)، كما أجريت بعض معايير الجودة الطبيعية والكيميائية والميكروبية والخواص الحسية علاوة على تقديربعض العناصر للمنتجات محل الدراسة. وأوضحت النتائج المتحصل عليها أن الخلطة (ب) حسنت قدرة البيرجرعلي الاحتفاظ بالماء علاوة على زيادة محتوي البروتين مقارنة بعينات الخلطة (أ). تشابه التركيب الكيميائي (عدا البروتين) فى منتجات البيرجر بخلطتى (أ ، ب) المطهية بالميكروويف. ارتفاع فى محتوى المواد النيتروجينيه الطيارة (٢٠مج /١٠٠جم من الوزن الرطب) وامين ثلاثى ميثيل (٢.٢٣ مج /١٠٠جرام) بينما انخفض قيمة حمض الثيوباربتيوريك فى عينات بيرجر بالخلطة (ب) مقارنة بالخلطة (أ). سجلت عينات البيرجر الخام (ب) تركيزا أعلى لعناصر الحديد والزنك والنحاس مقارنة بعينات الخلطة (أ) كما أدى القلى فى الزيت الى زيادة مستويات الحديد والنحاس والمنجنيز في منتجات الخلطة (أ) مقارنة بمنتجات الخلطة (ب). أدت الخلطات المستخدمة الى ارتفاع الحمل الميكروبى خاصة في عينات البيرجر بالخلطة (أ) حيث سجل المحتوي الكلي للبكتيريا ٤٩×١٠^{٣} خلية / جرام عينة، والبكتيريا المحبه للحرارة (٥٠ خلية / جرام). حسنت كلا من الخلتطين (أ ، ب) جميع الخصائص الحسية للمنتجات خاصة الرائحة فى منتجات الخلطة (ب). وبناءا على ماسبق فان الدراسة توصى بأن مكونات الخلطات الغذائية لها تاثيرواضح على معاييرجودة البيرجر، كما توصى باستخدام الخلطات الجاهزة (ب) لما لها من قدرة عالية على الاحتفاظ بالماء وارتفاع القيمة الغذائية وتحسين الخواص الحسية للبيرجر المصنع من سمك المبروك العادى.