USING THE CUTTLEFISH (*SEPIA OFFICINALIS* L.) FLESH IN PROCESSING OF NEW PRODUCTS

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Abstract

The common cuttlefish (*Sepia officinalis* L.) is known as one of the economically important species in the class cephalopods and the latter are one of the seafoods species. Seafoods are considered an excellent source of high quality protein which is rich in essential amino acids required for human. The cuttlefish is rejected by many people may be because of its unaccepted appearance, this could be easily overcomed by processing. Rejection continues although that the edible cuttlefish flesh has numerous benefits. Therefore, in this work the cuttlefish flesh is used in processing of new products. Four samples of nuggets processed from 100 % cuttlefish flesh (N_1), 75 % cuttlefish flesh with 25 % chicken breast meat (N_2), 50 % cuttlefish flesh with 50 % chicken breast meat (N_3) and 100 % chicken breast meat (N_4). Sensory evaluation was carried out for fried nuggets; From obtained it was observed that all samples had high grades of panelists, but the (N_2) sample was more preferred, whereas, this sample had the highest scores for all sensory properties except the texture, the (N_1) sample had the highest score of it. Also (N_1) sample was preferred than (N_3) sample and the lowest sensory properties scores were for (N_4) sample. Then chemical composition, texture profile analysis (firmness, cohesiveness, gumminess, chewiness, springiness and resilience), and physical and chemical properties were determined for all nuggets. From results it was noticed that the nuggets containing cuttlefish flesh were good source for protein and minerals, morefore, they had lower fat content. Also the nuggets cuttlefish flesh improved the plasticity and texture profiles and decreased the cooking loss, total volatile nitrogen (TVN) content and thiobarbituric acid (TBA) values. Of nuggets Therefore, the nuggets processed from cuttlefish flesh were very good in sensory, physical and chemical properties, besides they had high contents of protein and minerals and low fat.

INTRODUCTION

The edible flesh yield of cuttlefish is about 65.7 %, but this yield increases with length and weight of cuttlefish. About 32 pieces of cuttlefish with an average length per piece 24.5 cm (from 20.1 to 29.5 cm) were analyzed to study the chemical composition of edible cuttlefish flesh (mantle and arms "tentacles" together with part of head) which was 77.3 % water, o.25 % fat, 1.58 % ash and 18.29 % protein. Non-protein nitrogen was 0.746 % (Dabrowski *et al.,* 1970). The cuttlefish is among cephalopods family has lowest non-protein nitrogen (NPN) (Vaz-Pires *et al.,* 2008). .

The nutritional value of the cuttlefish mantle in the first 24 h was characterized (g/100 g) by 16.60 ± 0.10 g protein, 0.09 ± 0.01 g fat, 79.55 ± 0.14 g moisture and 1.39 ± 0.03 g of ash (Sykes *et al.,* 2009). According to Lee (1994), proximate composition for 21 species of cephalopods (g/100 g) showed 18 g protein and 79 g of moisture, thus leaving only 3 g of body mass for other biochemical compounds needed for life. When compared to fish, cephalopods have about 20% more protein, 80% less ash, 50–100% less lipid and 50–100% less carbohydrate. Also according to this author, cephalopod mantle does not store lipid and its storage is below 1g of its wet weight. Cephalopods consumption has been increasing worldwide during the past decades. The main reason for this increasing demand is that cephalopods are a good protein and low lipid source (Zlatanos *et al.*, 2006).

The cuttlefish has very small TBA values, since cephalopod mantle has a very small percentage of lipids in its mantle composition (Almansa *et al.,* 2006). Also (Sykes *et al.*, 2009) confirmed that TBA values for cuttlefish stored in ice for 13 days were only found to be significantly different between the 6th and 10th days ($p < 0.001$).TBA values were initially of 1.64 ± 0.71 on the 2nd, being 2.03 ± 0.55 on the 6th day and showing increase to 5.52 ± 0.62 mg of malonaldehyde/sample kg at the 10th day.

The chemical composition of breasts from 30 chickens (between 2.659 – 5.184 kg live weights) revealed 72.3 – 74.8 % moisture, 23.7 – 24.6 % protein, 0.94 – 1.28 % lipids and 1.16 – 1.37 % ash (Meluzzi *et al.*, 2009). While Bogosavljevic-Boskovic *et al.*, (2010) found that the chemical composition of breasts from two groups of broiler (chicken from 8 – 10 weeks) 6 male and 6 female for each group, showed 22.570 ± 0.14 – 23.720 ± 0.21 % protein, 1.960 ± 0.10 - 2.780 ± 0.13 % fat, 1.010 ± 0.03 - 1.100 ± 0.016 % ash and 26.047 ± 0.05 - 26.267± 0.11 % dry matter (about 73.733 – 73.953 % moisture).

Fried food is very common and generally acceptable worldwide; One popular product being chicken nuggets. Nuggets are a restructured meat product with batter and coater to retain the quality. The main composition of nugget is meat, usually from chicken, fish or combination with vegetable protein and gum. The composition of all batter is flour. Proximate composition and physicochemical characteristics of chicken nuggets are the most significant factors for consumer acceptability. Nuggets are a ready to cook and ready to eat product with simple preparation makes it a popular choice with consumers for a quick meal. It must contain not less than 60% meat in any formulation according to USDA (1991) and Lukmam *et al.,* (2009).

The objective of the present study was the utilization of cuttlefish benefits by processing of acceptable nuggets from cuttlefish flesh only, and from cuttlefish flesh with chicken meat. Cephalopods consumption has been increasing worldwide during the past decades, the reason for this increasing demand is that cephalopods are a good protein and low lipid source.

MATERIALS AND METHODS

Materials

Fresh whole raw cuttlefish flesh (each one of cuttlefish was about 1 kg) and fresh chicken breasts were purchased from the private sector shops in the local market at Giza, Egypt. They were transferred to the laboratory in an ice box. Potato was obtained from local market. Defatted soy flower (DSF) was obtained from the soybean processing pilot plant in Food Technology Research Institute and other ingredients (such as, egg, rusk, onion, garlic, lemon, salt and spices) obtained from local market.

Methods

Preparation of ingredients:

After washing cuttlefish flesh and chicken breasts, the excess water was drained, then amounts of both were minced by home mincer, and used directly for preparation of nuggets**.** Potato was boiled in water to become soft and then mashed. Defatted soy flower (DSF) was sieved. The onion and garlic were peeled and minced and the spices mixture (15 g) was prepared according to the following recipe: 2g Black pepper + 2g Thyme + 2g Ginger + 3g Cumin + 2g Cardamom + 2g Cubeb + 2g Laura leaves. Lemon juice was prepared before use.

Nuggets preparation

Four types of nuggets were prepared from cuttlefish flesh and chicken breasts as follows:

N_1 -All cuttlefish nuggets {100 % edible cuttlefish flesh (mantle and arms together with part of head)}.

N_2 -Cuttlefish – chicken nuggets (75% minced cuttlefish flesh + 25% minced chicken breasts meat).

N_3 - Cuttlefish – chicken nuggets (50% minced cuttlefish flesh + 50% minced chicken breasts meat).

N_4 - All chicken nuggets (100 % chicken breasts meat).

The four different types of nuggets were processed according to the following recipe: 600 g minced meat (either cuttlefish or chicken) + 150 g mashed boiled potato + 50 g DSF + 40 g egg + 30 g rusk + 40 g onion + 15 g garlic + 10 g salt + 15 g spices mixture + 50 ml lemon juice. The ingredients were mixed and homogenized by a laboratory chopper, after that nuggets samples were shaped, then dipped in the batter (corn flour, eggs and ripe milk), then placed in rusk. All samples were stored in refrigerator for 24 hr for ingredients adherence together. Sensory evaluation was carried out for fried frozen nuggets samples. The shallow carried frying was in corn oil for 5 minutes.

Sensory evaluation:

Sensory evaluations including appearance, odor, color, texture, taste and overall acceptability were carried out by 10 panelists according to Molander (1960) and judging scale was : 9 – 8 (very good), 7.9 – 7.0 (good), 6.9 – 6.0 (accepted) and less than 6.0 was unaccepted. Conventional statistical methods of sensory properties were used to calculate means and LSD. Statistical analysis (ANOVA) was applied to determine significant differences ($P < 0.05$) according to Snedecor and Cochran (1980).

Physical analysis:

Water holding capacity (WHC) and plasticity of samples were measured using the method of Golavin (1969). Cooking loss was calculated according to AMSA (1995).

Texture Profile Analysis (TPA):

Texture Profile Analysis was determined by a universal testing machine (Cometech, B type, Taiwan) provided with software. An Aluminum 25 mm diameter cylindrical probe was used in a Texture Profile Analysis (TPA) double compression test to penetrate to 50 % depth, at 1 mm/ s speed test. Firmness, gumminess, chewiness, cohesiveness, springiness and resilience were calculated from the TPA graphic. Both, springiness and resilience, give information about the after stress recovery capacity. But, while the former refers to retarded recovery (after the delay between compressions), the latter concerns instantaneous recovery (immediately after the first compression, while the probe goes up) (Bourne, 2003).

Chemical analysis:

Chemical composition (moisture, protein, fat and ash contents) was determined according the standard methods as reported in the (AOAC, 2005). Total carbohydrates content were determined as percentage, by calculating the difference between hundred and the sum of moisture, protein, fat and ash percentage. Thiobarbituric acid (TBA) value was determined as described by Egan *et al.,* (1981) and total volatile nitrogen (TVN) was determined according to the method published by Winton and Winton (1958).

RESULTS AND DISCUSSION

Table 1. Sensory properties of nuggets samples (average score)

Samples	Sensory Properties					
	Appearance	Color	Aroma	Texture	Taste	Overall acceptability
N_1	7.4 a	7.6 a	8.2 a	8.7 a	8.0 b	7.98 a
N_2	8.2 a	8.0 a	8.3 a	8.2 ab	8.5 a	8.24 a
N_3	7.8 a	7.4 a	8.0 a	7.7 b	7.7 c	7.72 ab
N_4	7.3 a	7.2 a	7.6 a	7.1 c	7.1 d	7.26 b
LSD	0.983	0.764	0.841	0.590	0.257	0.547

Means within a column with different letters are significantly different ($p<0.05$)

Data present in Table (1) shows the sensory properties (appearance, color, aroma, texture, taste and overall acceptability) of nuggets samples. It was observed from results for sensory evaluation that there were non-significant differences between four nuggets samples for appearance, color and aroma, but there were significant differences for texture, taste and overall acceptability. It was noticed that the score given for appearance was high for N_2 sample, followed by N_3 and N_1 samples, then N_4 sample. While, the scores given for color, aroma and overall acceptability were high for N_2 sample, followed by N_1 and N_3 samples, but less scores were for N_4 sample which did not contain cuttlefish meat. The score given for texture was high for N_1 sample, followed by N_2 and N_3, then N_4 sample. Therefore, the nuggets made from cuttlefish flesh or with percentage of it were more preferred to panelists than nuggets made from chicken meat only. From results, it was noticed that the N_2 sample was more preferred by panelists than the other nuggets.

Table 2. Chemical composition of nugget samples

Samples	Chemical composition (%)				
	Moisture	Protein	Fat	Ash	Carbohydrates
N_1	68.27 a	18.13 b	1.75 d	1.88 a	9.97 a
N_2	66.40 b	18.75 ab	3.08 c	1.69 b	10.08 a
N_3	64.63 c	19.38 a	4.01 b	1.55 c	10.43 a
N_4	63.57 c	19.69 a	4.47 a	1.27 d	11.00 a
LSD	1.292	0.832	0.159	0.018	1.361

Chemical composition of nuggets samples is shown in Table 2. It was noticed that moisture, protein, fat and ash contents displayed differences ($p < 0.05$), but there was not significant differences between samples for carbohydrates content. The nugget sample containing only cuttlefish flesh N_1 had the highest moisture and ash contents. This may be due to that the edible flesh of whole cuttlefish contained high levels of moisture and ash (Dabrowski *et al.,* 1970, Lee 1994 and Sykes *et al.,* 2009). While the nugget sample containing only chicken breast meat N_4 had the lowest moisture and ash contents, may be due to that chicken meat contained less levels of moisture and ash (Meluzzi *et al.*, 2009 and Bogosavljevic-Boskovic *et al.,* 2010). The moisture and ash contents for samples contained cuttlefish flesh and chicken breast meat N_2 and N_3 ranged between N_1 and N_4 samples. It was noticed that N_2 sample contained higher levels of moisture and ash than N_3 sample, because it had higher proportion from cuttlefish flesh. The protein content was slightly higher for N_4 sample than N_1 sample and for N_2 and N_3 samples falling between N_4 and N_1 samples, although the nuggets contained different percentages of cuttlefish flesh had good protein content and this may be because the cephalopods are a good protein and low lipid source (Zlatanos *et al.*, 2006). The fat content of nuggets samples was less with increasing of cuttlefish flesh proportion, whereas N_1 sample had the lowest fat content (600g cuttlefish flesh), followed by the N_2 sample (450g cuttlefish flesh), then N_3 (300g cuttlefish flesh), but N_4 sample (600g chicken breast meat) had the highest fat content. This may be due to that cephalopod mantle does not store lipid or its storage is below 1 g of its wet weight. This is due to the poor absorption of lipids (O'Dor *et al.,* 1984). All nuggets are approximately similar in carbohydrates contents.

Physical properties of nuggets samples are presented in Table 3, from which it was noticed that N_4 sample was more able to hold water than N_1 sample. This may be due to that N_1 sample had moisture content higher than N_4 sample as recorded in Table 2 results, while the ability to hold water for N_2 and N_3 samples were on average between $N_1$and N_4 samples which decreased with increasing cuttlefish meat in nuggets. Meanwhile the plasticity increased with increasing the proportion of cuttlefish meat in nuggets samples, accordingly N_1 sample had the highest plasticity and N_4 sample had the lowest plasticity. Cooking loss was higher for the N_4 sample than for N_1 sample, while N_2 and N_3 samples were on average between $N_1$and N_4 samples, whereas, it was noticed during frying of nuggets that occurred shrinkage in N_4 sample more than N_1 sample, may be due to that N_4 sample contains only chicken meat and N_1 sample contains only cuttlefish meat. In general, it is known that the meat and chicken contain higher amount of connective tissues than fish, accordingly the shrinkage occurs for meat and chicken products more than fish products.

Table 3. Physical properties of nugget samples

Samples	Physical properties			
	N_1	N_2	N_3	N_4
WHC (cm^2)	3.5	3.4	2.6	1.4
Plasticity (cm^2)	6.2	4.2	3.6	2.9
Cooking loss (%)	17.6	18.3	18.8	19.0

Texture Profile Analysis (TPA) results for fried nuggets were determined as firmness, cohesiveness, gumminess, chewiness, springiness and resilience values (Table 4). Results of TPA showed that N_1 sample was softer and tendered compared to other samples. Whereas, this sample had low values of firmness, gumminess and chewiness, may be due to that this sample had the highest plasticity (Table 3). This result was in agreement with the score given for texture of N_1 sample which had the higher score than other samples (Table 1). Therefore, determination of good textural qualities of nuggets should be done together with a sensory test in order to find out the most suitable range preferred by consumers as reported by Lukmam *et al.,* (2009). It was noticed that the values of firmness, gumminess, chewiness increased with decreasing the proportion of cuttlefish meat in nuggets samples, accordingly the nuggets became softer and tender with increasing the proportion of cuttlefish meat in nuggets samples. From results of cohesiveness and springiness, it was observed that their high values are an indicator for good texture quality. It was noticed that the N_2 sample had highest values. The textural properties of five brands of commercial chicken nuggets (hardness (firmness), cohesiveness, springiness, gumminess and chewiness) ranged between 33.36 – 77.45, 0.61 – 0.80, 1.00 – 1.23, 21.26 – 61.66 and 23.02 – 66.13, respectively, whereas hardness (N) = maximum force required to compress the sample (*H*), springiness (mm) = ability of sample to recover its original form after a deforming force was removed (*S*), cohesiveness = extent to which sample could be deformed prior to rupture (*A2/A1*, *A1* being the total energy required for first compression and *A2* the total energy required for the second compression), gumminess (N/mm2) = force necessary to disintegrate a semisolid sample for swallowing (*H* x cohesiveness), chewiness (N/mm) = work to masticate the sample for swallowing (*S* x gumminess) Lukmam *et al.,* (2009).

Table 4. Texture Profile Analysis (TPA) of Nuggets

Texture Profiles	Samples			
	N_1	N_2	N_3	N_4
Firmness (N)	5.69	9.17	12.45	16.52
Cohesiveness (N)	0.335	0.390	0.297	0.239
Gumminess (N mm^2)	1.906	3.576	3.698	3.948
Chewiness (N mm)	0.814	1.691	1.731	1.733
Springiness (mm)	0.427	0.473	0.468	0.439

Table 5. Chemical properties of nugget samples

Chemical properties	Samples			
	N_1	N_2	N_3	N_4
TVN (mg/ 100g sample)	1.4	2.1	3.5	6.3
TBA (mg malonaldehyde / kg sample)	0.3206	0.3377	0.3838	0.4337

Total volatile nitrogen (TVN) content and thiobarbituric acid (TBA) values as indicator for keeping quality of nuggets samples were showed in (Table 4). It was noticed that all nuggets samples had high quality because those samples had low TVN content and TBA values. Moreover, it was observed that the TBA values does not exceed 0.9 and4.5 mg malonaldehyde / kg sample for chicken and fish, respectively, according to (Egyptian standard, 1995) and the content of TVN does not exceed 30 mg/100 g sample for both according to (Egyptian standard, 2009). Also, it was observed that the quality was higher for nuggets contained cuttlefish meat, whereas TVN content and TBA values decreased with increasing the proportion of cuttlefish meat, this may be due to that the cuttlefish has low non-protein nitrogen (NPN) as member of cephalopods family and had TBA values very small, since cephalopod mantle has a very small percentage of lipids in its mantle composition (Dabrowski *et al.,* 1970, Almansa *et al.,* 2006, Vaz-Pires *et al.,*2008 and Sykes *et al.,* 2009).

CONCLUSION

A new product of cuttlefish flesh was very acceptable, retained good grades by the panelists and it had good physical and chemical attributes and it was noticed that the replacement 25% of cuttlefish meat by 25 % of chicken breast in nuggets improved the sensory, physical and chemical properties and this sample (N_2) was more preferred in taste by panelists.

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استخدام لحم السبيط في تصنيع منتجات جديدة

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قسم بحوث تكنولوجيا اللحوم والأسماك، معهد بحوث تكنولوجيا الأغذية ، مركز البحوث الزراعية ، جيزة ، مصر

السبيط الشائع (*Sepia officinalis* L.): معروف كأحد الأنواع الهامة تجاريا في طائفة من الرخويات، والأخيرة هي إحدي أنواع الأغذية البحرية. تعتبر الأغذية البحرية مصدر ممتاز للبروتين عالي القيمة الحيوية فهو غني في الأحماض الأمينية الأساسية التي يحتاجها الإنسان. السبيط غير مقبول لكثير من الناس وقد يكون ذلك لشكله ومظهره غير المألوف الأمر الذي يمكن التغلب عليه بالتصنيع حيث أن لحم السبيط له فوائد عديدة. بناء على ذلك، في هذه الدراسة تم استخدام لحم السبيط في تصنيع منتجات جديدة، أربع عينات من الناجتس صنعت من 100% لحم سبيط (N_1) ، 75% لحم سبيط مع 25% لحم صدور الدجاج (N_2)، 50% لحم سبيط مع 50% لحم صدور دجاج (N_3)، 100% لحم صدور دجاج (N_4). وقد تم التقييم الحسي للناجتس المقلية، ومن هذه النتائج وضح أن كل العينات حصلت على درجات عالية من المحكمين، لكن العينة (N_2) كانت مفضلة أكثر، حيث أن هذه العينة حظيت الأرقام الأعلى لكل الخصائص الحسية ما عدا القوام والعينة (N_1) حصلت على أعلى قيمة للقوام. أيضا العينة (N_1) كانت مفضلة عن العينة (N_3)، لكن العينة (N_4) اتصفت بأقل قيم في التقييم الحسى. وقد تم تقدير التركيب الكيميائي، تحليل صفات القوام، والخصائص الطبيعية والكيميائية لكل عينات الناجتس. من النتائج لوحظ أن الناجتس المحتوية على لحم السبيط كانت مصدر جيد للبروتين والمعادن، علاوة على ذلك كانت تتميز بمحتوي دهن منخفض. أيضا تصنيع الناجتس من لحم السبيط حسن البلاستكية وصفات القوام، وخفض الفقد بالطهي ومحتوي النتروجين الطيار الكلي وأرقام حمض الثيوباربتيوريك. بناء على ذلك، الناجتس المصنعة من لحم السبيط كانت جيدة جدا في الخصائص الحسية والطبيعية والكيميائية إلي جانب أنها تحتوي على محتويات عالية من البروتين والمعادن.