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The Effect Of Substitution Oyster Mushroom On Chemical Composition And Quality Attributes Of Meatballs.

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ABSTRACT

This work was carried out to study the effects of substitution fried oyster mushroom (*Pleurotus ostreatus*) by beef meat at levels (10, 20, 30 and 40%) and the effect of frying on chemical composition, physical, microbiological contamination and organoleptic properties of meatballs. The results showed that moisture, ash and carbohydrate contents of the raw meatballs were increased, but protein, fat contents and pH value were decreased by increasing levels of fried mushroom. As a result of frying, moisture was decreased, but protein, fat, ash and carbohydrate contents were increased compared to those of raw meatballs. The result showed that the physical properties as tenderness, plasticity and Feder values were increased, but, water holding capacity values were decreased by increasing levels of fried mushroom, on the other hand all properties were decreased as affected by frying compared to raw samples. In addition, the Feder value of raw or fried meatballs were less than 4, this means that these products had good quality. The total microbial count of raw meatballs was decreased by increasing levels of fried mushroom. Also, total microbial count of meatballs was decreased as affected by frying. Furthermore, both raw or fried meatballs were free of sporo-performing bacteria, *Coliform group* and *Salmonella spp*. Similarly, all the formulations of meatballs can be used for the preparation of acceptable organoleptic attributes. Also, the meatball containing 10% fried mushroom was the best sample compared to other samples.

Keywords: Fried- Mushroom- Meatballs- physical organoleptic properties – Microbiological**.**

INTRODUCTION

Meat is a good source of protein of high biological value. So there are trends of production of healthy and delicious meat free food for satisfaction of vegetarian and personal well beings. This resulted in increasing use of low cost vegetable protein such as textured soy protein, mushroom, wheat gluten, pulses etc. as a substitute for animal-protein. These simulated meat-like products, with similar textures, flavor, color and nutritive value can be substituted directly for meat to all sections of the society (Kumar et al. 2015). So consumption of vegetable proteins in food products has been increasing over the years because of animal diseases, global shortage of animal protein, strong demand for wholesome and religious (halal) food, and economic reasons (Asgar *et al*. 2010).

Oyster mushroom *Pleurotus ostreatus* is the commercially important edible famous mushroom for its delicious taste and high quantities of proteins, carbohydrates, minerals and vitamins as well as low fat (Al-Subhi, 2013). In addition to reducing energy intakes, the sensory qualities of mushrooms, including the textur and umami taste, may contribute to the utility of a meat-mushroom blend (Çağlarımak, 2007 and Myrdal Miller *et al*. 2014).

Use of cheap legumes as a meat extender increased the nutritional value (by increasing protein and fiber content and decreasing the fat content) of meat product. In addition, it enhanced the physical quality of the formulated patties by increasing the water holding capacity, and decreasing the cooking loss (Passos-Maria and Kuaye, 2002; Singh *et al*. 2008 and Kenawi *et a*l. 2009).

Although cooking results in the loss of some nutrients, it can also, convert other nutrients into a form that would otherwise not be used by the body. Furthermore, food frying is used to enhance the overall quality, texture and flavor of food products (Chukwu, 2009) .

For these reasons, the aim of this work was to prepare products with these properties and study changes of chemical composition and quality attributes of meatballs as affected by replacing with 10, 20, 30 and 40% fried oyster mushroom by beef meat and the effect of frying method on chemical composition and quality attributes these products**.**

MATERIALS AND METHODS

Materials:

Fresh oyster mushroom *(Pleurotus ostreatus*), beef meat, onions, spice mixture, chickpea, textured soy protein and rusk were obtained from the local market of Cairo city, Egypt.

Fried mushroom:

The mushroom was washed by water, and fried in oil at 200 °C for 2 minutes.

Preparation of beef meat, chickpea and textured soy protein:

Lean beef meat was minced in house mincer. Chickpea was soaked in water for 4 hours and boiled for 10 minutes, socked textured soy protein was prepared by adding 180 ml water to 100g textured soy protein for 10 minutes.

Preparation of meatballs:

Meatballs were prepared using the formula as shown in Table (1). Ground beef meat, spice mixture, salt, parsley, rusk, fried mushroom, boiled chickpea, soaked textured soy protein, garlic and onion were minced in house mincer. Forming of all meatball samples was done manually (each piece about 40 grams) deep frying at (300±2°C) for 8 min.

Methods:

Chemical analysis:

Gross chemical composition of raw materials, raw meatballs and fried meatballs were determined according to methods described by A.O.A.C (2000) for moisture, ash and protein by a nitrogen conversion factor of 6.25 (Kjeldahl method), and crude fat content using Soxhlet method, total carbohydrates were calculated by the difference: total carbohydrates = 100 – (% moisture + % protein + % fat + % ash. pH was measured using a pH meter (INOLAB 730) with a glass electrode as the method described by A.O.A.C.(1995).

Table: (1) Proportion of components meatballs:

Ingredients (%)	Control	First blend	Second blend	Third blend	Forth blend
Minced Beef	60	50	40	30	20
Fried mushroom	---	10	20	30	40
Socked textured soy protein	19	19	19	19	19
Boiled chickpea	6	6	6	6	6
Rusk	3	3	3	3	3
Onion	6	6	6	6	6
Garlic	1.5	1.5	1.5	1.5	1.5
Salt	1.5	1.5	1.5	1.5	1.5
Parsley	1.5	1.5	1.5	1.5	1.5
Sugar	1	1	1	1	1
Spice mixture	1.5	1.5	1.5	1.5	1.5

Nutritional evaluation of meat products:

Energy value was estimated by multiplying protein and carbohydrates by 4.0 and fat by 9.0 according to the methods recommended by A.O.A.C. (2000).

Grams consumed to cover the daily requirement (GDR) both energy and protein for adult man (25-50 years) were calculated by using recommended daily allowance (RDA) for energy and protein according to Anon (1989).

Percent of satisfaction of protein and energy when consumed 150 g from given products (ps/100) was also calculated using RDA according to Anon (1989)

Physical properties:

Textur indices as protein water coefficient (PWC),Protein water fat coefficient (PWFC) and water-protein coefficient (WPC) values were determined according to Tsuladze (1972).

The water holding capacity (WHC) and plasticity were determined by using the method recommended by Grau and Hamm (1957).

Feder value was determined according to the method described by Pearson (1970).

Cooking loss and cooking yield:

Five meatballs were weighted before and after frying in oil for 10 min. The cooking loss and yield were calculated as described by Niamnuy *et al*. (2008).

% Cooking loss = (Mass before cooking – Mass after cooking) / Mass before cooking × 100

Microbiological examination:

Total viable counts were determined according to the method described by Anon (1984). And Spore-forming bacteria were determined according to the method described by Gould and Hurst (1983). S.S. Agar medium (Oxoid) was used for enumeration of *Salmonella spp* and plates incubated at 37 °C for 48 hours as described by Bryan (1991). *Coliform group* was detected on MacConkey agar (Oxoid) at 35-37 °C for 48 hours, according to the method described by Anon (1988).

Organoleptic properties of products:

All fried meatballs were subjected to organoleptic tests (by ten judges) according Judging scale for color, aroma, taste, texture and overall acceptability. Organoleptic properties were evaluated by panelists composed of 10 graduate students from the Home Economic department. Sensory evaluation was carried out according to Watts *et al*. (1989).

Statistical analysis:

Statistical analysis was carried out using all the assays were carried out in triplicate. The results are expressed as mean values and standard deviation (SD).

RESULTS AND DISCISSION

Chemical composition of raw materials:

As given in Table (2), data show the chemical composition of raw materials used in meatballs preparation on wet weight. Beef meat had the highest protein, but it had the lowest ash and carbohydrate contents compared to other raw materials except fried mushroom had the highest fat content compared to raw materials. Boiled chickpea and soaked textured soy protein had more moisture, protein and fat, but it had low ash and carbohydrates compared to those of chickpea and textured soy protein. These results may be due to soaked process that caused absorption of water and decrease in dry matter. Fried mushroom had low moisture, ash and carbohydrates, but it had high protein and fat contents compared to those of fresh oyster mushroom.

Table (2): Chemical composition of raw materials on wet weight

Constituents		Beef Meat	Mushroom	Fried mushroom	Chickpea	Boiled chickpea	Textured soy protein	Socked textured soy protein
Moisture %	WW	70.3	91.7	82.8	8.6	63.0	7.1	64.9
	DM	29.7	8.3	17.2	91.4	37.0	92.9	35.1
Protein)%	WW	18.8	2.1	4.8	21.0	10.5	48.6	19.2
	DW	63.3	25.1	27.7	23.0	28.4	52.3	54.7
Fat %	WW	9.8	1.0	7.9	9.7	4.7	7.2	2.3
	DW	33.0	11.9	46.0	10.6	12.8	7.8	6.5
Ash %	WW	0.8	0.7	0.9	3.0	0.9	7.7	2.2
	DW	2.69	8.7	5.3	3.2	2.3	8.3	7.7
Carbohydrate (%)	WW	0.3	4.5	3.6	57.8	20.9	29.4	11.4
	DW	1.01	54.3	20.5	63.2	56.5	31.7	31.1
Energy value kcal/100g	WW	164.6	35.4	104.7	402.1	167.9	376.8	143.1
GDR energy (g)	WW	1761.8	8192.1	2769.8	721.2	1727.2	769.6	2026.6
GDR protein(g)	WW	335.1	3000.0	1312.5	300.0	600.0	129.6	328.1

These results of beef meat are confirmed by those of EL-Damasy (2006) and de Almeida *et al*. (2006). Moreover, results of soy flour agree with that of Khalil *et al*. (2002). Furthermore, result of chickpea is in conformity with those of Rincón *et al*. (1998), and Osorio-Díaz *et al*. (2008). Results of soaked textured soy protein is harmony with that of man *et al*. (2015). Results about boiled chickpea are in agreement with those of Alajaji and El-Adawy (2006) and man *et al*. (2015). In addition, results obtained about raw *Pleurotus ostreatus* mushroom are in agreement with that of Ahmed *et al*. (2012). The results of fried mushroom is harmony with that of Pogoń *et al*. (2013), who found that fried *Lactarius deliciosus* mushrooms were characterized by a level of moisture lower than fresh mushrooms, and higher of other constituents such as fat, protein, carbohydrates, and ash.

Data from Table (2) showed that the nutritional evaluation of raw materials used in meatballs on wet weight. The results cleared that, the highest GDR protein was found in fried mushroom, but the lowest GDR protein value was found in soaked textured soy protein. These results were due to fried mushroom had the lowest protein content, but socked textured soy protein had the highest protein content compared to others. The highest energy value (kcal/ 100g) was found in boiling chickpea so, it had the lowest GDR energy value compared to other raw materials. This result was due to boiled chickpea had the highest content of carbohydrates compared to other raw materials. As well, the result of raw mushroom had lower energy value (kcal/100g) and lower protein content compared to fried mushroom so; it had higher values of GDR energy and GDR protein compared to those of fried mushroom. It may be due to increase in fat and protein contents as affected by frying method. These results are confirmed by those of Pogoń *et al*. (2013), who reported that the caloric value of the fried products was three times higher than that of fresh fruiting bodies.

On the other hand, the result showed that boiled chickpea and socked textured soy protein had lower energy value kcal/100g, GDR energy (g) and GDR protein (g) compared to chickpea and textured soy protein, this result was due to water absorption that increase moisture and decrease dry matter as a result to socked and boiling. These results confirmed by those of Huma *et al*.(2008) and Kajihausa *et al*. (2014).

Physical properties of raw materials:

Data found in Table (3), showed that the physical properties as texture indices and Feder value of raw materials used in meatballs preparation. The result showed that soaked textured soy protein had the highest values of PWC and PWFC compared to those of other raw materials. This result may be due to its high protein, so using as additives in foods, especially in meat products to improve the functional properties of the system such as water binding and textural properties. Proteins are considered the principal water binding substance in meat and meat products as found by Olkiewicz *et al*. (2007).

Fried mushroom had high values of PWFC and PWC, but it had low value of WPC, so fried mushroom has firmer than that of raw mushrooms. This result may be due to fried mushroom had low moisture and high protein and fat contents compared to those of raw mushroom. This result due to fried methods caused a decrease in moisture content and increases in protein and fat contents. These results are in harmony with those of Krbavcic and Baric (2004).

Table (3): Quality attributes of raw materials.

Attributes	Beef Meat	Mushroom	Fried mushroom	Boiled chickpea	Socked textured soy protein
PWFC	0.234	0.023	0.052	0.155	0.286
PWC	0.268	0.023	0.057	0.167	0.296
WPC	3.736	43.794	17.438	6.004	3.379
WHC	2.83	---	---	---	---
Feder value	3.575	12.471	8.926	1.956	2.008

WHC: Water holding capacity PWC: protein -water coefficient PWFC: protein-water-fat coefficient

The Feder value of fried mushroom is lower than that of raw mushrooms, so fried mushroom is suitable for formulating beef balls compared to raw mushroom. On the other hand, The Feder value of all raw materials except raw and fried mushroom were less than 4, so these materials, except raw or fried mushroom were good and suitable for formulating beef balls according to Pearson (1970).

All these results about quality attribute of raw materials as confirmed by those of Youling and Kenney (1999).

The result about WHC of beef meat is in agreement with that of Sharaf Eldin *et al*. (2013) and El - Refai1 *et al*. (2014).

Microbial examination of raw materials:

Data found in Table (4), showed the microbial examination of raw materials that used in meatballs preparation. The result showed that the beef meat had a higher total count compared to fried mushroom. On the other hand raw mushroom had a higher total count compared to fried mushroom. These results due to frying method.

Table (4): Microbial examination of raw materials.

Contamination bacteria	Parameters	Beef Meat	Raw mushroom	Fried mushroom
Total Count	cfu/g	$1.7x10^4$	$5x10^4$	$1.3x10^2$
Spore-forming	cfu/g	Nil	2x10	Nil
Coliform group	D	-	+	-
Salmonella spp	D	-	+	-

cfu : Cell for Unit. +: Positive. - : Negative Contamination Bacteria. D: Detection. --: Not examination. TC: total count S-FC: spore-forming bacteria

Raw mushroom was positive in *Coliform group* and *Salmonella spp*, but fried mushroom was negative for these bacteria. Moreover, spore-forming bacteria was not detected in fried mushroom. These results were due to frying.

All these results are in agreement with those of Das *et al*. (2013), who reported that microbiological analysis revealed that the pressure frying and conventional frying were sufficient to make the product safe for consumption.

Chemical composition of meatballs with different levels of mushroom as affected by frying:

Data concerning in Table (5) showed that the chemical composition of the raw meatballs as affected by the substitution fried oyster mushroom by meat and frying. The result showed that moisture, ash and carbohydrate contents were increased, but protein, fat contents and pH value of the raw meatballs were decreased by increasing levels of fried mushroom, this might be due to the high contents of moisture, ash, carbohydrates and low contents of protein, fat and pH values of fried mushroom compared to beef meat as shown in Table (2).

All these results confirmed by those of El-Refai1 *et al.* (2014), who indicated that raw materials affect the chemical and physical properties of meat products. Also, Kassem and Emara (2010), who found that addition of vegetables significantly increased the moisture, ash and carbohydrate and reduced the fat content of raw burger patties.

After frying, the result showed that fried meatballs had low moisture and high protein, fat, ash and carbohydrate contents compared to those of raw meatballs. This loss in moisture could be attributed to dehydration process and fat absorption during frying and increased in dry matter. All these results are in conformity with those of Juárez *et al.* (2010) and Wan Rosli *et al.* (2011).

Table (5): Chemical composition of meatballs with different levels of mushroom as affected by frying:

Constituents			Moisture %	Protein %	Fat %	Ash %	Carbohydrate (%)	pH
Control	R	WW	65.34	16.63	7.93	2.85	7.25	6.75
		DM	34.66	47.96	22.89	8.23	20.92	
	F	WW	53.5	21	12.13	3.47	9.9	6.81
		DW	46.5	45.16	26.52	7.47	20.85	
First blend	R	WW	66.58	15.31	7.54	2.86	7.71	6.62
		DW	33.42	45.82	22.7	8.61	22.87	
	F	WW	50.71	20.15	14.15	3.89	11.1	6.76
		DW	49.29	40.83	28.77	7.28	23.12	
Second blend	R	WW	67.85	14	7.16	2.83	8.16	6.51
		DW	32.15	43.54	22.27	9.13	25.06	
	F	WW	50.93	18.38	15.39	3.89	11.41	6.71
		DW	49.07	37.45	31.36	7.94	23.25	
Third blend	R	WW	69.22	12.78	6.63	3.02	8.35	6.47
		DW	30.78	41.5	21.54	9.8	27.16	
	F	WW	51.31	16.63	16.41	3.98	11.67	6.65
		DW	48.69	34.14	33.7	8.16	24	
Forth blend	R	WW	70.55	11.38	6.13	3.2	8.74	6.43
		DW	29.45	38.62	20.82	10.86	29.7	
	F	WW	56.9	14.77	13.19	4.05	11.09	6.59
		DW	43.1	34.26	30.61	9.39	25.74	

R: Raw- F: Fried -WW: Wet Weight- DM: Dry Mater.

Physical properties of meatballs with different levels of mushroom as affected by frying:

Data in Table (6) showed that the physical properties of meatballs as Textur indices and Feder value. PWC and PWFC values were gradually decreased and WPC value was increased in all processed meatballs by increasing the level of fried mushroom, because the tenderness of fried mushroom was more than that of beef meat. As a result of the PWC and PWFC values of fried mushroom were less, but WPC was more than those of beef meat as shown in Table (3). So the tenderness of meatballs was increased by increasing levels of fried mushroom. Also, as affected by frying, both PWC and PWFC values of fried meatballs were gradually increased, but WPC value was decreased compared to others of raw samples. So the tenderness of meatballs was decreased. This might be due to the decrease in moisture and the increase in protein and fat contents of all meatballs as affected by fried method as shown in Table (4).

WHC values were decreased, but plasticity values were increased by increasing the level of fried mushroom, so meatballs containing 40% fried mushroom had the lowest WHC and the highest plasticity values compared to those of other samples. On the other hand, WHC of fried meatballs was decreased, but plasticity values were increased compared to those of raw samples. This result might be due to the reduction of the tenderness.

Feder values of the raw meatballs were increased by increasing the levels of fried mushroom, but Feder values of fried meatballs were lower than those of raw samples, because there were decreases in moisture contents and increases in dry matter. In addition, the Feder value of all meatballs was less than 4, this means that these products had good quality according to Pearson (1970).

Table (6) Physical properties of meatballs with different levels of mushroom as affected by frying.

Attributes		PWC	PWFC	WPC	Feder value	WHC	Plasticity
Control	R	0.254	0.227	3.930	2.444	2.55	3.27
	F	0.393	0.320	2.548	1.566	1.07	1.75
First blend	R	0.230	0.207	4.348	2.573	2.64	3.41
	F	0.397	0.311	2.516	1.441	1.20	1.88
Second blend	R	0.206	0.187	4.846	2.715	2.78	3.65
	F	0.361	0.277	2.772	1.512	1.31	1.99
Third blend	R	0.185	0.168	5.418	2.866	2.94	3.79
	F	0.324	0.245	3.086	1.590	1.43	2.07
Forth blend	R	0.161	0.148	6.202	3.026	3.15	3.98
	F	0.260	0.211	3.852	1.903	1.54	2.18

WHC: Water holding capacity PWC: protein -water coefficient PWFC: protein-water-fat coefficient.

All these results about tenderness were in agreement with those of Olkiewicz and Moch (2008), who found that raw materials are the most important moderator of chemical and rheological properties of the final products. And, Zhang *et al.* (2005), they observed that tenderness of fish, meat and meat products increased with the decrease in PWC and PWFC values. Also, Zhang *et al.* (2004) reported that the final textured of the product is influenced by these heat treatments, especially products using flour as a binder, e.g., sausages, nuggets and meatballs in many comminuted meat products.

Data given in Table (7) showed that, the cooking loss of meatballs was increased by increasing the level of fried mushroom, so the cooking yield was decreased. It may be due to fried mushroom had low protein content compared to that of beef meat. These results might be due to decrease the protein content of meatballs. Low water holding capacity caused a decrease in yield as shown in table (4) So meatballs containing 40% fried mushroom had the highest cooking loss and the lowest cooking yield compared to other samples.

All These results confirmed with Kassem and Emara (2010), who reported that vegetable extended burger had the highest cooking loss percent compared to control samples.

Table (7) Changes in cooking drip loss and cooking yield of meatballs with different levels of mushroom as affected by frying.

Parameters	Control	First blend	Second blend	Third blend	Forth blend
CDL	24.5	25.7	27.1	28.7	30.1
CY	75.5	74.3	72.9	71.3	69.9

CDL: Cooking drip loss CY: Cooking yield.

Nutritional evaluation of meatballs with different levels of mushroom as affected by frying:

Data in Table (8) showed that the nutritional evaluation of raw meatballs, energy Kcal/100g and SP/100g energy values of the raw meatballs were decreased so GDR energy and values were increased as substitution levels of beef meat by fried mushroom was increased, this result was due to the energy value of fried mushroom was lower than that of beef meat, because fried mushroom has low contents of fat and protein compared to those of beef meat as shown in Table (2). On the other hand, energy values of all fried meatballs were increased so GDR energy was decreased. These results are due to increasing in carbohydrates, fat and protein contents of fried samples compared to raw samples. Also, GDR protein of fried samples was gradually decreased compared to others raw samples. This result might due to increase in protein content of fried samples compared to other raw samples.

Percent of satisfaction (SP)/150g of protein and energy were gradually decreased as substitution levels of beef meat by fried mushroom in raw meatballs. This result is due to decrease the protein or protein and fat contents in raw samples.

All These results are in agreement with those of Abdrabou (2005) and Pogoń *et al*. (2013).

Table (8): Energy value, GDR of protein and energy of meatballs with different levels of mushroom as affected by frying.

Constituents		Kcal /100g	GDR Energy	GDR protein	SP/150g energy	SP/150g protein
Control	R	166.89	1737.67	378.83	8.63	39.595
	F	232.77	1245.87	300.00	12.04	50.000
First blend	R	159.94	1813.18	411.50	8.27	36.452
	F	252.35	1149.20	312.66	13.05	47.976
Second blend	R	153.08	1894.43	450.00	7.92	33.333
	F	257.67	1125.47	342.76	13.33	43.762
Third blend	R	144.19	2011.24	492.96	7.46	30.429
	F	260.89	1111.58	378.83	13.49	39.595
Forth blend	R	135.65	2137.85	553.60	7.02	27.095
	F	222.15	1305.42	426.54	11.49	35.167

Microbial examination of meatballs with different levels of mushroom as affected by frying:

Data found in Tables (9 and 10) showed that the total microbial count of raw meatballs was decreased by increasing levels of fried mushroom. This result may be due to that fried mushroom had low total count microbial compared to beef meat. On the other hand' the total microbial counts of fried meatballs were decreased compared to raw meatballs. This result may be due to fried method. All these results are in agreement with those of Rai *et al*. (2016).

The results showed that *Coliform group* and *Salmonella spp*. we're not detected in raw or fried samples. This might be due to the absence *Coliform group* and *Salmonella spp*. in raw materials used in meatballs preparation (Table 3), and also, it is due to the cleaning of equipment's. These results are in agreement with that obtained by Gibbons *et al*. (2006), who reported that improved sanitary practices on food contact surfaces and during handling of products, reduced the risk of *Listeria* spp. and other pathogen bacteria. Also, the result was due to frying as found by Das *et al*. (2013) and Kim *et al*. (2015).

Table (9): Microbial counts of meatballs with different levels of mushroom as affected by frying.

Products	Contaminated bacteria	Parameter	Processing R	Processing F
Control	Total Count	Cfu /g	6.3X10^{3}	2.5X10^{3}
	Spore-forming	Cfu /g	Nil	Nil
First blend	Total Count	Cfu /g	5.6 X10^{3}	2.2 X10^{3}
	Spore-forming	Cfu /g	Nil	Nil
Second blend	Total Count	Cfu /g	5.2X10^{3}	2X10^{3}
	Spore-forming	Cfu /g	Nil	Nil
Third blend	Total Count	Cfu /g	4.8X103	2X103
	Spore-forming	Cfu /g	Nil	Nil
Forth blend	Total Count	Cfu /g	4.6X103	1.7X103
	Spore-forming	Cfu /g	Nil	Nil

cfu : Cell for Unit.

Table (10): Some pathogenic bacteria of meatballs with different levels of mushroom as affected frying.

Products	Contaminated bacteria	Parameter	Processing R	Processing F
Control	*Coliform group*	D	Nil	Nil
	Salmonella spp	D	Nil	Nil
First blend	*Coliform group*	D	Nil	Nil
	Salmonella spp	D	Nil	Nil
Second blend	*Coliform group*	D	Nil	Nil
	Salmonella spp	D	Nil	Nil
Third blend	*Coliform group*	D	Nil	Nil
	Salmonella spp	D	Nil	Nil
Forth blend	*Coliform group*	D	Nil	Nil
	Salmonella spp	D	Nil	Nil

Organoleptic properties of meatballs:

The results given in Table (11) showed that the organoleptic properties of meatballs. All meatballs had overall acceptability. Furthermore, meatballs containing 10% fried mushroom had the highest scores of texture and color compared to other meatballs. As well meatballs with no fried mushroom had the highest scores of taste, odor, and overall acceptability compared to others. So meatballs containing 10% fried mushroom were the best sample compared to other meatballs containing 20, 30 and 40% fried mushroom**.**

Table (11): Changes in Organoleptic properties of fried meatballs samples

Parameters	Control	First blend	Second blend	Third blend	Forth blend
Color	7.7 ±0.14	7.75 ±0.07	8 ±0.28	7.7 ±0.42	8 ±0.28
Textur	8.2 ±0.00	8.6 ±0.28	8.25 ±0.78	8.1 ±0.42	7.6 ±0.00
Taste	8.05 ±0.21	8.55 ±0.07	8.45 ±0.35	8.4 ±0.00	7.8 ±0.28
Odor	8.15 ±0.49	8.6 ±0.28	8.2 ±0.28	8.75 ±0.0	7.8 ±0.00
Overall acceptability	7.9 ±0.14	8.35 ±0.49	8.2 ±0.28	8.75 ±0.07	7.4 ±0.14
Composition scores	40 ±0.57	41.85 ±0.21	41.1 ±0.42	41.7±0.71	38.6 ±0.14
Average	8 ±0.14	8.37±0.07	8.22 ± .25	7.7 ± .09	7.72 ±0.14

All these results are harmony with those of Kullamethee *et al*. (2010), who found that while the amount of straw mushroom was increased in formula of pork ball, the firmness, toughness and sensory taste were decreased. And, Myrdle Miller *et al*. (2014), who reported that in some meat-based dishes, meat can be substituted with mushrooms without compromising the flavor of the dishes. This is because of the presence of unique and so-called “umami” flavor-enhancing compounds in mushrooms**.**

CONCLUSION

Meatballs formulation containing partially 10% percent fried mushroom had higher protein, fat, better protein quality, physical properties, and nutritional evaluation, lower cooking losses and higher mean organoleptic scores compared to the other formulations containing fried mushroom. In addition, all the formulations of meatballs can be used for the preparation of acceptable organoleptic attributes.

REFERENCES

A.O.A.C. 1995. Official Methods of Analysis. Association of Official Analytical Chemists. 16th Ed. Washington, D.C.

A.O.A.C. 2000. Official Methods of Analysis. Association of Official Analytical Chemists. 17th Ed. Washington, D.C.

Abd Rabou E. A. EL-H. A. 2005. Nutritional and technological studies on some fish products. M.Sc. Thesis, Fac. Of Specific Edu., Mansura Univ.

Ahmed, M., Abdullah, N., Ahmed, K.U., Bhuyan, M. H. M. B. 2012.Yield and nutritional composition of oyster mushroom strains newly introduced in Bangladesh. Pesq. Agropec. Bras., Brasília, 48, (2), 197-202.

Alajaji, S.A., El-Adawy, T.A. 2006. Nutritional composition of chickpea (*Cicer arietinum L.*) as affected by microwave cooking and other traditional cooking methods. J. of Food Composition and Analysis. 19, (8), 806–812. (Abstract).

Al-Subhi, F. M. M. 2013. Evaluation of Mushrooms Broth Cube and Its Compared With Maggi Broth Cube Products in Saudi Arabia. J. Am Sci. 9(5),250-255.

Anon. 1984. Difco manual: Dehydrated Culture Media And Reagents For Microbiology, 10th Ed., p. 1155. Difco Laboratories, Detroit.

Anon. 1988. WHO World Health Organization: Health Education Food Safty. WHO, 88(7), 32.

Anon. 1989. RDA Recommended Dietary Allowances Food And Nutritive Board. National Academy of Sci. National Res. Council. Washington, D.C.

Asgar, M.A., Fazilah, A., Huda, N., Bhat, R., Karim, A.A. 2010. Nonmeat Protein alternatives as meat extenders and meat analogs . Comprehensive Reviews in Food Sci and Food Safety. (9), 513:529.

Bryan, F.L. 1991. Teaching HACCP techniques to food processors and regulatory officials. Dairy, Food and Environmental Sanitation. (11), 562-568.

Çağlarımak, N. 2007. The nutrients of exotic mushrooms (*Lentinula edodes* and *Pleurotus* species) and an estimated approach to the volatile compounds, Food Chemistry. (105), 1188–1194.

Chukwu, O. 2009. Influences of drying methods on nutritional properties of tilapia fish (*Oreochromis nilotieus*). J. of Appl. Sci Res. 5(6),600 – 603.

Das, R., Pawar, D. P. and Modi, V. K. 2013. Quality characteristics of battered and fried chicken: comparison of pressure frying and conventional frying. J Food Sci, Technol . 50(2),284–292.

de Almeida, J. C., Perassolo, M. S., Camargo, J. L., Bragagnolo, N., Gross, J. L. (2006). Fatty acid composition and cholesterol content of beef and chicken meat in Southern Brazi

Revista Brasileira de Ciências Farmacêuticas (RBCF) Brazilian Journal of Pharmaceutical Sciences. (42), 109-.117.

EL-Damasy, A.M.I. 2006. Substitution of fat in some meat production by some vegetable oils. M.Sc. Thesis, Fac. of Agric., Mansoura Univ.

El - Refai1,A., El – Zeiny,A.R., Abd Rabo, E.A. El. A. (2015).quality attributes of mushroom-beef patties as a functional meat product. Journal of Hygienic Engineering and Design.49-62.

Gibbons, I.S., Adesiyun, A., Seepersadsingh, N., Rahaman, S. 2006. Investigation for possible source(s) of contamination of ready-to-eat meat products with *Listeria spp*: and other pathogens in a meat processing plant in Trinidad. Food Micro. 23 (4), 359-366. (Abstract).

Gould, G.W., Hurst, A (1983) The bacterial spore. Volum 2 Academic Press , Inc: New York.

Huma, N., Anjum, F. M. Sehar, S., Khan, M. I., Hussain, S. 2008. Effect of soaking and cooking on nutritional quality and safety of legumes. Nut & Food Sci, 38 (6),570 – 577.

Grau., R., Hamm, R., (1957) cited by Hamm, R. 1960 Advances of Food (Res) Academic Press, New York and London 10:356.

Juárez, M., Failla, S., Ficco, A., Pena, F., Avilés, C., Polvillo, O. 2010. Buffalo meat composition as affected by different cooking methods. J. Food and Bioproducts Processing. 88, 2-(3): 145–148. (Abstract).

Kassem, M.A. G., Emara, M.M.T. 2010. Quality and acceptability of value-added beef Burger. World J. Dairy & Food Sci., 5 (1), 14-20.

Kajihausa, O.E.1., Fasasi, R.A., Atolagbe, Y.M. 2014. Effect of different soaking time and boiling on the proximate composition and functional properties of sprouted sesame seed flour. NIFOJ. 32 (2), 8 – 15.

Kenawi, M. A., Abd EL-Salam, R.R., El-Sherif, S. A. 2009. The effect of mung bean powder, and/or low fat soy flour as meat extender on the chemical, physical, and sensory quality of buffalo meat product. Biotechnology In Animal Husbandry. 25 (5-6), 327-337.

Khalil, M.M., Hussein, M.A., Kassem, A.E., Abou-Raya, M.A., Abd El-Monem, A.M. (2002). Studies on modified baby foods and bioavailability of iron, calcium and vitamin A. J. Adv. Agric. Res., 7(4),731-747.

Kim, K-Il., Lee, S-Y., Hwang1, I-G., Yoo1, S-M., Min, S-G., Choi, M-J. 2015. Quality characteristics of beef by different cooking methods for frozen home meal replacements. Korean J. Food Sci. An. 3(4), 441-448.

Krbavcic, I.P., Baric, I.C. 2004. Influence of deep fat frying on some nutritional parameters of novel food based on mushrooms and fresh soft cheese. J. Food Chem., 84 (3), 417-419.

Kullamethee, p., Meetha, N., Sinao, R., Deephai, S. 2010. Development of pork ball enriched with straw mushroom. J of Public Health, http:/ /imsear. hellis. org/handle/123456789/131008. (Abstract).

Kumar, P., Chatli , M.K., Mehta, N., Singh, P., Malav, O.P., Verma, A.K. 2015. Meat analogues: health promising sustainable meat substitutes. Critical Rev In Food Sci And Nutr .http:// dx.doi.org /10.1080 /10408398. 2014. 939739. (Abstract).

Mang, D. Y., Abdou, A. B., Njintang, N. Y., Djiogue, E., Bernard, J. M., C., Scher, J., Mbofung, M. C. 2015. Effect of dehulling and boiling on the physico-chemical, functional and pasting properties of two varieties of Mucuna bean (*Mucuna pruriens L.*) flours. Food Measure. (9),435–447 .

Myrdal Miller. A., Mills, K., Wong, T., Drescher, G., Lee, S. M., Sirimuangmoon, C. , Schaefer, S., Langstaff,S., Minor, B., Guinard, J-X. 2014. Flavor-enhancing properties of mushrooms in meat-based dishes in which sodium has been reduced and meat has been partially substituted with mushrooms. J. Food Sci. 79(9), 795-804.

Niamnuy C., Devahastin, S., Saponronnarit, S. 2008. Changes in protein compositions and their effects on physical changes of shrimp during boiling in salt solution. Food Chem., (108) 165-175.

Olkiewicz, M., Tyszkiewicz, S., Wawrzyniewicz, M. 2007. Effect of basic chemical composition and functional additives on rheological characteristics of selected meat products. Acta Agrophysica, 9(1), 147-169.

Olkiewicz, M., Moch, P. 2008. Effect of raw material formulation on basic composition and rheological properties of a model product of mortadella type. Acta Agrophysica, 11 (1), 159-173.

Osorio-Díaz, P., Agama-Acevedo, E., Mendoza-Vinalay, M., Tovar, J., Bello-Pérez, L. A. 2008. Pasta added with chickpea flour: chemical composition, in vitro starch digestibility and predicted glycemic index. Cienciay Tecnología Alimentaria. 6(1),6-12 .

Passos-Maria, H.C.R., Kuaye, A.Y. 2002. Influence of the formulation, cooking time and final internal temperature of beef hamburgers on the destruction of *Listeria monocytogenes*. Food control, (13), 33-40.

Pearson, D. 1970. The Chemical Analysis of Food. 6th (Ed.) J. A. Church hill, London. pp: 510-515.

Pogoń, K., Jaworska, G., Duda-Chodak, A., Maciejaszek, I. 2013. Influence of the Culinary Treatment on the Quality of *Lactarius deliciosus*. Foods *(2)*, 238-253.

Rai, R., Bhattacharyya D., Praveen, P. K.; Ganguly, S., Dalai, N., Shekhar, S. 2016. The effect of different cooking procedures on microbiological quality of chevon meat balls. The Asian J. Anim. Sci., DOI: 10.15740/HAS/TAJAS/11.1/xx-xx. In press.

Rincón, F., Martı´nez, B., Victoria Ibáñez, M. 1998. Proximate composition and ant nutritive substances in chickpea (*Cicer arietinum L.)* as affected by the biotype factor. J. of the Sci of Food and Agric. (78), 382–388.

Sharaf Eldin, I.M.A., Babiker, S.A., Elkhidir, O.A., El-Bukhary, H.A.A. 2013. Characteristics of beef from intensively fed western Baggara bulls and heifers: quality attributes and chemical composition. Iraqi Journal of Veterinary Sciences, 27(1), 45-48.

Singh, D.G., Abas, A.W., Kaur, D., Sogi Singh, D.S. 2008. Characterization and functional properties of proteins of some Indian chickpea (*Cicer arietinum*) cultivars. J. of the Sci of Food and Agric. 88(5),778 - 786 .

Tsuladze, E.A. 1972. The relationship between the tenderness of fish meat and its protein water and protein water fat coefficient. Fish Industry. 48 (7), 68-69.

Youling L. X., Kenney, P. B. 1999. Functionality of Proteins in Meat Product. Reciprocal Meat Conf Proceedings, (52),67-69.

Wan Rosli, W. I., Solihah, M. A., Mohsin, S. S. J. 2011. On the ability of oyster mushroom (*Pleurotus sajor-caju*) confering changes in proximate composition and sensory evaluation of chicken patty. International Food Res. J. 18(4), 1463-1469.

Watts, B.M., Yumaki C.L., Jeffery, L.E., Elais, LG. (1989). Basic sensory methods for food evaluation. The International Development Research Centre, Ottawa, Canada.

Zhang, L., Lyng, J.G., Brunton, N.P. 2004. Effect of radio frequency on the textur, colour and sensory properties of a large diameter comminuted meat product. Meat Sci., 68: 257-268.

Zhang, S.X., Farouk, M.M., Young, O.A., Wieliczko, K.J., Podmore, C.2005. Functional stability of frozen normal and high pH beef. J. Meat Sci., (69),765–772.

تأثير إحلال عيش الغراب المحارى على التركيب الكيميائي وخواص الجودة في كرات اللحم .

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يهدف هذا العمل الى دراسة مدى تأثير إحلال عيش غراب المحارى المحمر بنسب ١٠و ٢٠ و٣٠ و ٤٠% بدلا من اللحم البقرى، وكذلك دراسة مدى تأثير عملية التحمير على التركيب الكيميائي و الخصائص الفيزيقية و التلوث الميكروبي والخواص الحسية لكرات اللحم المصنعة من اللحم البقري. أشارت النتائج انه حدث ارتفاع في محتوى الرطوبة و الرماد و الكربوهيدرات بينما حدث انخفاض في البروتين و الدهن وقيمة الرقم الهيدروجيني في كرات اللحم الخام بزيادة مستوى عيش الغراب المحمر، ومن جانب أخر نتيجة لعملية التحمير حدث انخفاض في محتوى الرطوبة وقيمة الرقم الهيدروجيني، وارتفاع في محتوى البروتين والدهن والكربوهيدرات بالمقارنة بكرات اللحم الخام. كما أظهرت النتائج أنه حدث ارتفاع في الخواص الفيزيقية مثل المرونة والمطاطية و قيمة Feder value بينما حدث انخفاض في القدرة على مسك الماء بزيادة مستويات عيش الغراب المحمر، بينما حدث انخفاض في هذه الخواص نتيجة لعملية التحمير بالمقارنة بالمنتجات الخام . بالإضافة إلى ذلك كانت قيمة Feder value في المنتجات الطازجة والمحمرة اقل من ٤ .لذلك هذه المنتجات ذات جودة جيدة. ونتيجة لعملية التحمير حدث انخفاض في العد الكلى الميكروبي في كرات اللحم الطازجة نتيجة لإحلال عيش الغراب المحمر كما حدث انخفاض فى العد الكلى الميكروبي نتيجة لعملية التحمير. بالإضافة إلى ذلك كانت كل من كرات اللحم الخام والمحمرة خالية من البكتريا الخضرية ومجموعة القولون والسالمونيلا. كل الخلطات من كرات اللحم كانت مقبولة حسيا كما كانت كرات اللحم المدعمة بنسبة ١٠% عيش غراب محمر لديها أفضل الخواص الحسية بالمقارنة بباقي كرات اللحم الأخرى.