Journal of Home Economics

Volume 27, Number (2), 2017

Journal of Home Economics

http://homeEcon.menofia.edu.eg

ISSN 1110-2578

Chemical, technological and microbiological evaluation of chicken burgers mixing with dried oyster mushroom (*Pleurotus eryngii*)

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Abstract: This study was carried out to prepare mushroom chicken burger by partial substitution of dried mushroom. The organoleptic properties, gross chemical composition, caloric value and physical properties of this prepared burger were evaluated. A microbiological examination was also conducted during frozen storage of prepared burger. The addition of 10, 20 and 30% of dried mushroom to chicken burgers formulated did not change in both sensory properties and consumers' acceptability. The reduction of sensory scores for texture and hardness was observed simultaneously with the level of dried mushroom used. Chicken burger prepared with 30% of dried mushroom, recorded the highest scores of moisture, ash and fiber in both raw and cooked burgers while, protein, fat, carbohydrate and total caloric values recorded lower concentrations. On the other hand, fat and water retention, cooking yield, Feder value and the water holding capacity of prepared burgers were significantly (p<0.05) elevated with the increasing level of dried mushroom compared to control. Values of shrinkage and cooking loss parameters were decreased with increasing substitution percentage of dried mushroom comparing with the control treatment. Total bacterial counts of all treatments were decreased during frozen storage. Treatments containing dried mushroom were markedly decreased the bacterial count. Pathogenic bacteria, Coliform group and *Salmonella sp.*, were not detected in all treatments during frozen storage.

Keywords: Chicken burger, mushroom powder, chemical composition, physical properties, cooking characteristics, microbiological evaluation.

Introduction

Edible mushrooms are cultivated and consumed as food or food ingredients in various food preparation and processed food products. Freshly harvested edible mushrooms contain a low fat content (0.38% to 2.28%), resulted in a low calorific value contribution of mushrooms on total daily energy intake (Chye *et al.,* 2008). Edible mushrooms also provide a nutritionally significant content of vitamins B1, B2, B12, C, D and E (Ferreira *et al.,* 2009; Heleno *et al.,* 2010). Edible mushrooms could be a source of many different nutraceutical such as unsaturated fatty acids, phenolic compounds, tocopherols, ascorbic acid and carotenoids. Thus, they might be used directly in diet and promote health through an additive and synergistic effects of all bioactive compounds (El- Magoli *et al.,* 1996 ;Pereira *et al.,* 2012). Mushroom prove to be excellent foods that can be used in well balanced diets for their low contents of fat, energy and high contents dietary fiber and functional compounds (Manzi *et al*,2001)

On the other hand, the cultivated edible mushroom normally had high moisture content at more than 80%,dry matters of mushrooms contain more than 25% protein, less than 3% crude fat and almost 50% of total carbohydrate (Kotwaliwale*etal*.,2007). Therefore, mushrooms are considered to be healthy due to low in calories, sodium, fat and cholesterol levels. Moreover, mushrooms are an important constituent of a diet for a population suffering from atherosclerosis (Dunkwal *et al*., 2007). Mushrooms, also named as a white vegetables or a boneless vegetarian meat that can provide balanced diet in sufficient quantities for human nutrition and contain various potent pharma-nutritional compounds. Hence, the uniqueness of promising food ingredients and flavour together with enhanced health promoting properties in mushrooms is at present one of the key global market trends (Netzel *et al*., 2007).

Oyster mushroom has a great potential with a great nutritional value. It was quite rich in protein, contained high levels of essential amino acids and fibers and poor in fat, they are good source of iron, copper, calcium, potassium, vitamin D, zinc and folic acid, etc. In addition selected strains of dried mushrooms are used to produce mushroom capsules and extracts. The mushroom is a highly concentrated food and unsurpassed for flavour in addition to being a completely satisfying meal (Alam and Raza, 2001).

Previous study was successfully substituted the white flours with oyster mushroom powder in bakery products, soups, sauces, instant noodle, meat-based products, pasta and flour mixes (Wan Rosli *et al*., 2012). Extensive studies have been done in the use of various types of fat replacer and plant dietary fiber in processed meat and poultry products in attempts at increasing dietary fiber and lowering of fat content (Desmond *et al*., 1998; Dongowski *et al*., 2003; Yilmaz and Daglioglu *et al*., 2003)

The meat industry is one of the most important industries in the world. Meat considers the main source of protein and iron. However, it contained also high fat content, saturated fatty acids, and cholesterol and their association with cardiovascular diseases, some types of cancer and obesity. Therefore, the launch of new meat products are designed to provide alternative healthy diets (Fernández-Ginés *et al.*,2005).

It is purported that by replacing meat based ingredients with oyster mushroom into patty formulation saving the ingredient cost. The use of non-meat ingredients that can help convey desirable texture and, mainly, enhance water-holding ability. In this regard, carbohydrates and fiber have been successful in improving cooking yield, reducing formulation cost and enhancing texture (Akoh, 1998 and El-Refai*et al.*, 2014).

Total bacterial count (TBC) has been used to assess sanitary quality, safety and organoleptic ability (Fliss *et al*., 1991). Coliform bacteria are particularly useful as part of microbiological criteria to indicate post processing contamination of foods that have been processed (heating, irradiation, or chlorination for safety). They are also useful indicators in guidelines at critical control points, particularly after heat processing (DC, 1985).

The objective of this work was to prepare a functional mushroom-chicken burger. The effect of addition dried mushroom with different levels to chicken burger on chemical, physical, organoleptic properties and microbiological examination of the product and during frozen storage for 6 months was studied.

Materials and methods

Materials

Chicken breast, starch, spices mixture, and salt were obtained from the local market at Kafr El-Sheikh governorate, Egypt. Fresh oyster mushroom (*Pleurotus eryngii)*and soy protein were obtained from Agricultural Research Center, Giza, Egypt. All chemical, buffers and solvents in grade analysis were purchased from AlGomhoria Trading Company for Drug, Chemicals and Medical Instruments, Cairo, Egypt.

Methods

Preparations of dried mushroom:

Oyster mushrooms were washed with tap water, blanched with steam for 7 min and dried in a thermostatically controlled oven ith air fan at 60°C for 5 hours, then milled using a Laboratorial disc mill to pass through a 20 mesh/inch sieve (Deshpande and Tamhne,1981).

Preparation of mushroom chicken burgers:

Chicken breast was well blended with dried mushroom to produce individual mixtures with 0, 10, 20 and 30 % replacement levels by substituting the chicken breast with dried mushroom as shown in table (1).

All treatments were prepared in Home Economics Department, Faculty of Specific education; Kafr El-Sheikh Univ. Burgers were prepared according to the procedure described by Wan Rosli *et al.,*(2006) with slight modifications. The chicken breast and dried mushroom were blends using a food processor. The minced chicken blends were stored at –18^{o}C until processing time. Isolated soy protein was blended with water and shortening at a ratio of 1:5:5, the emulsion prepared (called pre-emulsion) was kept in a chiller (25^{0}C) until ready for use.

Each of prepared materials were mixed separately for 5 min at medium speed, using a Moulinette machine (Model 320, cod 25, France) to obtain homogeneous mixture. Subjected to final grinding (0.5 cm plate), and processed into burgers (100 g weight, 1.2 cm thick and 10 cm diameter). Prepared burgers were placed on plastic foam meat trays, wrapped with polyethylene film and kept frozen at -18°C until further analysis(Ali *et al.,* 2011).The blend of materials are tabulated in table(1)

Organoleptic properties

Prepared burgers were assessed for a number of sensory characteristics which were carried out by 50 consumers consisting of students and staff of Home Economics Department, Faculty of Specific Education, Kafr Elsheikh University. The cooked burger samples were equally divided into 7 portions. Each portion of product sample was placed in sensory cups with lids coded with 3 digit random numbers. Panelists were instructed to evaluate colour, texture, taste, flavour, hardness, juiciness and overall acceptability using 10 point scale for grading the quality of samples (Crehan *et al*., 2000).

Table (1): Formulas of mushroom chicken burgers

Ingredients (%)	Control	Treatment(1)	Treatment(2)	Treatment(3)
Chicken breast	65	55	45	35
Shortening	10	10	10	10
Potato starch	8	8	8	8
Mushroom powder	0	10	20	30
***Spices mixture**	2.0	2.0	2.0	2.0
Salt	2.0	2.0	2.0	2.0
Isolated soy protein	3.0	3.0	3.0	3.0
Water	10	10	10	10
Total	100	100	100	100

*****Spices mixture is containing(white pepper, nutmeg ground, turmeric ground, onion powder, oregano ground and garlic powder**,** 1g of each type at equal proportions.

Proximate chemical analysis

Moisture, protein, ash, fat and fiber content were determined according to the methods described by AOAC (2005), carbohydrate contents were estimated by difference.

Total caloric values (Kcal) were calculated using method of Watt and Mersil (1975), where 4.27 Kcal for g protein and 9.02 Kcal for g lipid and 4.10 Kcal for g carbohydrate.

Cooking characteristics

Cooked burgers were cooled to 21°C for 1 h and blotted before weighing. Samples were weighted before and after cooking. To estimate the amount of fat and moisture retained in the samples, the following calculations were performed according to(Aleson-Carbonell *et al*., 2005).

$$\text{Fat retention (\%)} = \frac{100\ [\text{Cooked weight (g)} \times \%\ \text{fat in cooked samples}]}{[\text{Raw weight (g)} \times \%\ \text{fat in raw samples}]}$$

$$\text{Moisture retention (\%)} = \frac{100\ [\text{Cooked weight (g)} \times \%\ \text{moisture in cooked samples}]}{[\text{Raw weight (g)} \times \%\ \text{moisture in raw samples}]}$$

$$\text{Cooking yield (\%)} = \frac{\text{Cooked weight (g)}}{\text{Raw weight (g)}} \text{x100}$$

Physical properties

Shrinkage

Samples surface areas were measured before and after cooking and shrinkage was calculated according to the method of El-Akary (1986)as follows;

$$\text{Percent of shrinkage} = \frac{A_1 - A_2}{A_1} \times 100$$

Where; A_1 and A_2 are surface areas before and after cooking respectively.

Feder value

Feder value which is used for assessing one of the physical attributes in meat was determined in burger by the procedure described by Pearson (1976), using the following equation:

$$\text{Feder value} = \frac{\%\ \text{Water}}{\%\ \text{Organic non-fat content}}$$

Where: % organic non-fat = 100 – (% fat + ash + % moisture)

Cooking loss

Cooking loss values were calculated the weight difference of three prepared burgers before and after cooking using following equation (Crehan*et al*., 2000).

$$\text{Percent of cooking loss} = \frac{\text{Weight before cooking} - \text{Weight after cooking}}{\text{Weight before cooking}} \text{x100}$$

Water Holding Capacity (WHC)

WHC was calculated according to Denhetog- Meishchke *et al*., (1997).

Microbiological examination of chicken burger formulae

Total bacterial count (T.B.C.) and detection of coliform groups and *Salmonella sp* were carried out according to A.P.H.A (1971).

Statistical Analysis

All the obtained data were statistically analyzed by SPSS computer software. The calculated occurred by analysis of variance ANOVA and follow up test LSD by SPSS version.11 according to Abo-Allam (2003).

Results and Discussion

Sensory evaluation

The effect of substituted chicken meat by mushroom powder on the colour, texture, taste, flavour, hardness, juiciness and overall acceptability of chicken burger were illustrated in table (2). Generally, all properties investigated were influenced by dried mushroom level substituted. The colour, taste, flavour, juiciness and overall acceptability of this burger were improved. These parameters were increased associated with the increase of the replacement level of dried mushroom comparing with control treatment except the overall acceptability of 10% mushroom chicken burger was the lowest value. These results are in acceptance with those reported by El-Refai *et al.*,(2014), who found that when dried mushroom was increased to 12% the overall acceptability of beef patties was decreased. It is clear that the scores of all sensory properties were in the range between 7.78-9.28 with the burger containing 30% dried mushroom. The present sensory data also showed that all chicken burgers formulated with 10, 20 and 30%driedmushroom were not significantly different (P>0.05) compared to control chicken burgers for all properties. On the other hand, chicken burgers formulated with 10, 20 and 30% mushroom powder had slightly higher scores (8.53-8.61) and (8.71- 8.78) for color and flavor respectively, but were not significantly different with those of control.

In contrast, reduced scores for hardness were noticed symmetrical with the level of dried mushroom used in burger formulations which might be attributed to the moisture higher content of fresh mushroom *Pleuratussajor-caju* (PSC). (Kotwaliwale *et al*.,2007). The juiciness of chicken burger increased proportionally with the level of mushroom powder. This increase in juiciness could be attributed to the higher in water holding capacity of oyster mushroom (Wan Rosli *et al*., 2011). The addition of dried mushroom was markedly improved the quality of burgers productive and give the best results without any undesirable changes in sensory properties.

Table (2): Organoleptic properties of mushroom chicken burger

Treatments	Color	Texture	Taste	Flavor	Hardness	Juiciness	Overall Accepta-bility.
Chicken burger (control) 0% dried mushroom	8.48 ±0.91 a	9.06 ±0.97 a	8.66 ±1.40 a	8.66 ±1.11 a	8.36 ±0.79 a	7.53 ±1.10 ab	8.76 ±1.09 a
Chicken burger with 10% dried mushroom	8.53 ±1.09 a	8.83 ±0.91 a	9.00 ±1.23 a	8.71 ±1.07 a	8.13 ±0.89 a	7.80 ±0.89 ab	8.56 ±1.08 a
Chicken burger with 20% dried mushroom	8.57 ±0.75 a	8.53 ±0.97 a	9.10 ±1.25 a	8.74 ±1.14 a	8.06 ±1.03 a	8.03 ±1.05 a	8.79 ±0.97 a
Chicken burger with 30% dried mushroom	8.61 ±0.72 a	8.63 ±0.91 a	9.28 ±1.05 a	8.78 ±1.40 a	7.89 ±1.09 ab	8.38 ±1.18 a	8.86 ±1.13 a

Values in the same column with the same letter are not significantly different at $P \leq 0.05$.

Proximate chemical composition for fresh and dried mushroom

Table (3) shows the proximate chemical compositions of freshly harvested and dried oyster mushrooms content were 88.51, 3.72, 1.32, 0.57, 2.05 ,5.88 % and 45.18kcal/100 g for moisture, protein, ash, fat, fiber, carbohydrate and energy kcal, respectively. These results are similar to that reported by (Dikeman *et al.*,(2005); Chye *et al.*,(2008), who noticed that fresh mushroom contained high moisture content (more than 80%) and low fat content (0.38% to 2.28%) indicated low calorific value (kcal) contribute a small proportions of mushrooms total daily energy intake. The composition of fresh mushrooms under study was more or less similar to that reported by Zakia (1976);Gupta and Sarma (2004). As shown in table (3), dried mushroom contained protein content of 32.38 %, also, ash, fat, fiber, carbohydrate and energy kcal/100 g content in oyster mushroom recorded 11.49, 4.96, 17.84, 51.17 and 392.80kcal/100 g respectively**.** Dried mushroom had lower contents of protein, fat and ash compound to fresh mushroom. The decrease in protein content could be attributed to Millared reaction which usually happens between reducing sugars and basic amino acids. Also, the decrease in fat content might be due to reaction between fat and reducing sugars. These results are in accordance with those reported by Dikeman *et al.*,(2005); El-Refai *et al.*,(2014),who reported that the protein content of various selected dried mushroom ranged from 23.4 to 43.5%.The present results are also in agreement with the dietary fiber content of the fruiting body of other mushroom species which ranged from 30-40% dry weight as reported by Oyetayo *et al.*,(2007).

Table (3): Proximate chemical composition for fresh and dried mushroom (g/100 g dry weight basis)

Contents %	Fresh mushroom	Dried mushroom
Moisture	88.51	
Protein	3.72	32.38
Ash	1.32	11.49
Fat	0.57	4.96
Fiber	2.05	17.84
Carbohydrate	5.88	51.17
Energy kcal/100 g	45.18	392.80

All values are average of three determinations.

Gross chemical composition and caloric values ofraw and cooked mushroom chicken burger:

The results of gross chemical composition of chicken burger formulated with dried mushroom are shown in table (4 and 5). Moisture content of raw and cooked chicken burger ranged from 56.15% to 65.71 and 46.25% to 55.11% respectively. Control raw and cooked chicken burger contained lower moisture content (56.15 and 46.25%) than those of burger formulated with dried mushroom, while cooked chicken burger containing 30% dried mushroom recorded the highest moisture content (55.11%). These results confirmed with those of Berry and Wergin(1993); Khalil, (2000) and Mansour, (2003). They reported that cooked beef patties formulated with different levels of hydrated potato flakes had

Table (4): Gross chemical composition and caloric values of raw chicken burger formulated with dried mushroom (On dry weight bases)

Treatments	Moisture	Crude protein	Ash	Crude Fat	Fiber	Carboh-ydrates	Total caloric Value (K.cal/100gm)
Chicken burger(control) 0%dried mushroom	c 56.15 ±0.13	a 15.17 ±.21	b 1.12 ±0.02	a 10.19 ±0.21	c 1.04 ±0.02	17.37 ± 1.00	227.91 .
Chicken burger10% dried mushroom	b 58.07 ±0.19	b 14.76 ±.29	ab 1.85 ±0.02	b 8.75 ±0.02	b 1.88 ±0.02	16.57 ±0.61	209.89
Chicken burger 20% dried mushroom	ab 63.47 ±0.31	b 14.93 ±0.37	a 2.06 ±1.01	bc 7.98 ±0.02	a 2.33 ±1.00	11.56 ±0.40	183.13
Chicken burger 30% dried mushroom	a 65.71 ±0.47	c 13.85 ±0.23	a 2.27 1.01	c 7.01 ±0.10	a 2.92 ±1.00	11.16 ±0.41	168.13

Values are average ±SD of three replicates.
a-c: Within a column, means with the different letter are significantly different at P≤0.05.

Table (5): Gross chemical composition and caloric values of cooked chicken burger formulated with dried mushroom.(On dry weight bases).

Treatments	Moisture	Crude protein	Ash	Crude Fat	Fiber	Carbo-hydrates	Total energy (K.cal/ 100g)
Chicken burger (control 0% dried mushroom	c 46.25 ±0.18	a 18.37 ±.41	b 1.76 ±0.01	a 11.17 ±0.34	d 1.24 ±0.01	22.45 ± 1.00	263.81 .
Chicken burger 10% dried mushroom	b 50.17 ±0.29	b 17.86 ±.39	ab 2.05 ±0.01	b 9.35 ±0.06	c 2.40 ±1.00	20.57 ±0.61	237.87
Chicken burger 20% dried mushroom	ab 52.27 ±0.31	bc 16.92 ±0.31	a 2.46 ±1.00	c 8.18 ±0.04	b 3.13 ±1.00	20.17 ±0.40	221.98
Chicken burger 30% dried mushroom	a 55.11 ±0.67	d 15.85 ±0.33	a 2.77 1.00	d 6.82 ±0.10	a 4.20 ±1.52	19.45 ±0.61	202.58

Values are average ±SD of three replicates.
a-d:Within a column,means with the different letter are significantly different at P≤0.05.

significantly ($p \leqslant 0.05$) higher moisture content than that of control. In contrast**,** Manzi *et al*. (2004), reported that different mushroom species cooking process resulted in a loss of moisture and a subsequent concentration of nutrients.

For protein the highest value was found in raw and cooked chicken burger control treatment (15.17, 18.37%) and the lowest value in cooked chicken burger with 30%dried mushroom (15.85%). Results showed significant ($P \leq 0.05$) difference among control and all treatments. The concentration of protein was decreased proportionally with the level of mushroom powder used in raw and cooked chicken burger. These results are in line with those of Wan Rosli *et al.*,(2011).

Data presented in table (4 and 5), exhibited decreases in fat content of raw and cooked chicken burger as a result of dried mushroom levels increment. The lowest values (7.01, 6.82%) were observed in chicken burger with 30%dried mushroom respectively. These results showed significant ($p \leq 0.05$) decrease in fat contents with increasing levels of dried mushroom. Such results are in agreement with Mansour (2003). Meanwhile, all chicken burger containing dried mushroom significantly ($P<0.05$) recorded lower concentration of fat. On the other hand, the percentage, of ash and fiber in cooked chicken burger ranged from 1.76 to 2.77% and 1.24 to 4.20 % respectively. The raw and cooked chicken burger with 30% dried mushroom recorded highest values of ash and fiber contents comparing with control, the addition of dried mushroom caused significant increase in ash and fiber contents (Nieburg, 2012). Carbohydrates were among predominant macronutrients in the present study, the carbohydrate content of burger with addition 10, 20, and 30% dried mushroom showed lower content compared toraw and cooked chicken burger control.

This may possibly due to the high moisture contents (Tables 4 and 5), presented in raw and cooked chicken mushroom burgers. Cooking may promote a loss of nutrient due to interactions among constituents, chemical reactions, and solubility in cooking medium and thermal degradation (Manzi *et al*., 2004). From the same results in Tables (4 and 5), it was clear that elevating dried mushroom addition decreased caloric value of chicken burger. The lowest caloric value in raw and cooked chicken burger with 30%dried mushroom (168.13, 202.58K.cal/100g) may be due to low content of fat. These results are confirmed with those of Eldemery (2010)**,** who reported that energy values of the tested beef burgers were decreased with increasing non fat materials such as orange albedo.

Cooking characteristics and physical properties of cooked chicken burger formulated with dried mushroom:

Cooking characteristics and physical properties of cooked chicken burger formulated with dried mushroom are presented in Ttable (6).The results of fat and moisture retention of cooked chicken burger formulated with dried mushroom were similar with the trend of cooking yield. It was proportionally increased with the increasing of fiber content in burger formulations and higher amount recorded at higher levelsof dried mushroom. Dietary fibers increased cooking yield because of their high ability to keep moisture and fat in the matrix. These results are in line with those reported by Aleson-Carbonell *et al.,(*2005).Control cooked chicken burger recorded 71.74% fat retention and 53.91% moisture retention, while cooked mushroom chicken burger recorded fat and moisture retention ranging from 72.40 -73.80%and 58.53-63.61%, respectively.

Concerning control burgers, fat was more easily removed during cooking, probably due a low density of meat protein matrix, along with a high fat instability. This is in agreement with those of Suman and Sharma (2003), who studied the effect of grind size and levels on the physico-chemical and sensory characteristics of low-fat ground buffalo meat patties. Compared to the control treatment, chicken burger formulated with dried mushroom showed an increase ($p \leqslant 0.05$) in shrinkage and cooking loss values. The shrinkage of the size and shape of cooked chicken burger formulated with dried mushroom during cooking could be due to the binding and stabilizing properties of dried mushroom fibers, which held the meat particle together and resisted changes in the shape of the product. Shrinkage was also decreased with increasing the level of dried mushroom in burger formulations. Even though this cooking characteristic effect was higher in control, but it was significantly different ($p \leqslant 0.05$) with all treatments.

In fact, the high cooking loss was in control burger. This could be attributed to the high loss of moisture and fat during cooking Sheard*et al.,* (1998) reported that cooking loss of grilled and fried beef patties contained 9-30% of fat were ranging from 22 – 36%. Also, Pinero *et al.,*

(2008) reported the cooking loss was 25 and 29%, respectively, in beef patties incorporated with oat fibers. On the other hand, El-Refai*et al.*,(2014) found that cooking loss of beef patties was decreased by increasing fortification level of dried mushroom.

Table (6): Cooking characteristics and physical properties of cooked chicken burger formulated with dried mushroom

Treatments	Fat-retention (%)	Water-retention (%)	Cooking Yield (%)	Shrinkage (%)	Feder Value (%)	Cooking loss (%)	Water Holding capacity (%)
Chicken burger (Control) 0%dried mushroom	c 71.74 ±1.33	c 53.91 ±1.32	d 65.45 ± 1.01	a 27.50 ±1.00	a 1.13 ±1.02	a 34.55 ±0.16	d 35.82 ±1.12
Chicken burger 10 %dried mushroom	b 72.40 ±2.11	b 58.53 ±1.16	c 67.75 ± 2.12	b 22.50 ±1.01	a 1.31 ±1.02	b 32.25 ±0.60	c 43.55 ±1.21
Chicken burger 20 % dried mushroom	a 73.0 4 ±2.15	b 58.86 ±1.57	b 71.5 ±1.34	c 18.50 ±0.16	a 1.41 ±1.02	c 28.75 ±0.32	b 47.27 ±1.32
Chicken burger 30 %dried mushroom	a 73.80 ±0.89	a 63.61 ±1.50	a 75.85 ± 1.51	d 14.50 ±1.02	a 1.56 ±1.02	d 24.15 ±0.61	a 52.55 ±1.02

Values are average ±SD of three replicates.

a-d: Within a column, means with the different letter are significantly different at $p\leqslant 0.05$.

Cooking yield was significantly ($p\leqslant0.05$) higher in chicken burger prepared withdried mushroom. Burger formulated with 30% dried mushroom recorded the highest one (75.85%) compared to other treatments. This is probably due to the ability of fiber to create a tridimensional matrix, holding not only water, but also fat added to the formula, avoiding losses of fat and water during cooking (Warner andInglett1997;El-Refai*et al.*,2014).

On the other hand, the results in the same table(6) indicate that the feder value recorded high value in chicken burger formulated with 30% dried mushroom (1.56 %),and no significant difference ($p\leqslant0.05$)was observed between control and all treatments. Feder value for all treatments were less than (4.00 %), this means that all treatments had good qualities according to Pearson (1991), who reported that good quality meat products have feder values less than 4.00 %.

For the water holding capacity, the highest value was mentioned in treatment of chicken burger that contain30% dried mushroom (52.55%) and the lowest one recorded with the control treatment (35.82%. In this relation, water holding capacity was increased significantly ($p \leqslant 0.05$) with increasing the levels of dried mushroom, this explains the reduced loss in weight during cooking burger. The reason may be due to the ability of plant proteins to hold the water and formation a network with it as functional properties (Quinon and Poton,1979; El-Refai*et al.,*2014).

Microbiological examination:

Total bacterial count, coliform group and *Salmonellasp*. forprepared chicken burgers during storage at -18^{0}C for 6 months are given in table (7). Total bacterial counts are considered a quality indicator for food samples; there is no direct correlation between this and the presence of pathogenic microorganisms (Arvanitoyannis *et al.,* 2005). It could be noted from table (7) that, total bacterial count of all treatments decreased during frozen storage. Chicken burger treatments with dried mushroom had total bacterial count lower than that of control; it may be due to its contents of antimicrobial agents in phenolic compounds form. Total bacterial count was ranged from 4.9to 4.5x10^3 CFU/g at zero time to 1.9 to 1.1x10^2 at the end of storage period, these results confirmed by ICMSF, (1978). Coliform group counts and *Salmonella sp.* were not detected in all treatments before and after zero time during frozen storage. Conclusively, these data are adapted to Egyptian standard (ES 1688: 2005) of frozen beef burger, which included maximum limit of TBC of 10^5, while *Salmonella sp*. was not detected. Coliform bacteria are particularly useful as part of microbiological criteria to indicate post processing contamination of foods (that have been processed by heating, irradiation, or chlorination for safety). They are also useful indicators in guidelines at critical control points, particularly after heat processing (DC, 1985).

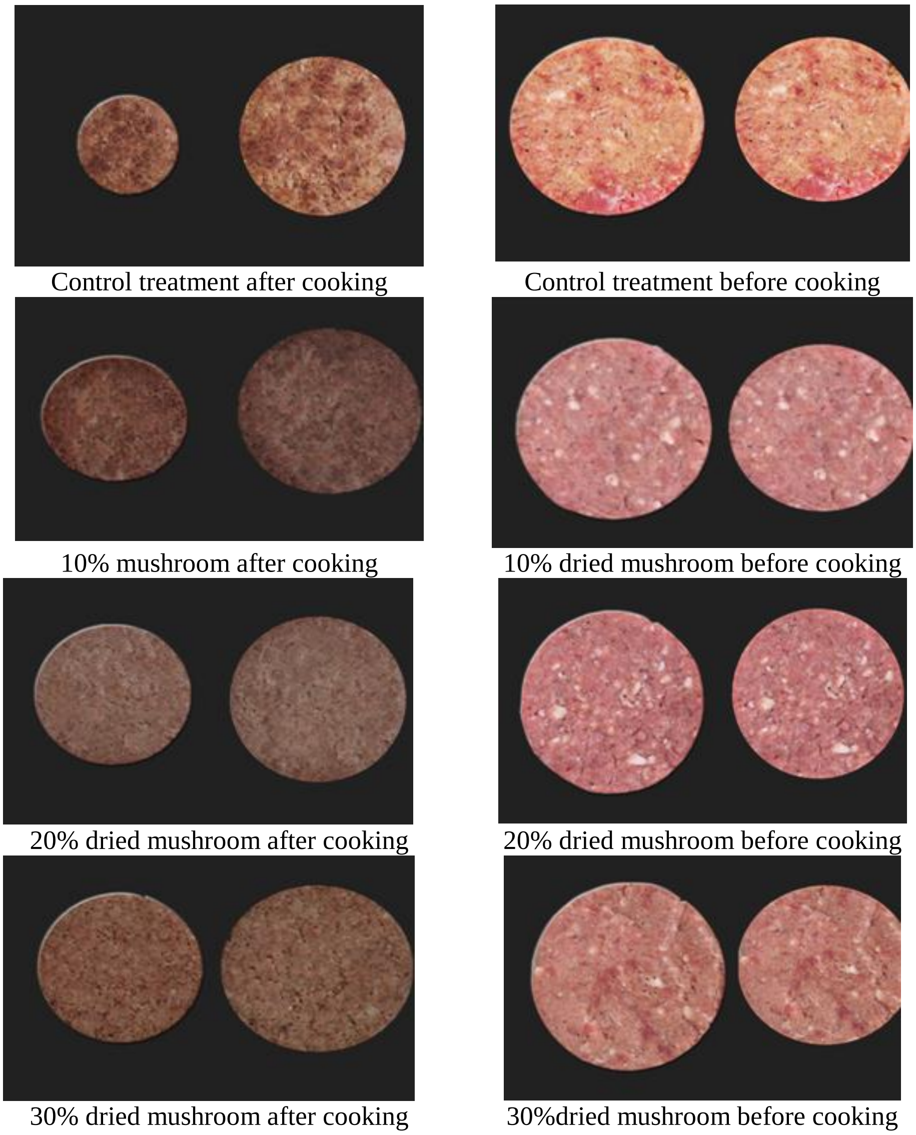

Figure 1. Show photos of chicken burger before and after cooking as affected by mushroom incorporation.

Table (7): Effect of frozen storage at -18^{0}C for 6months on microbial count of raw chicken burger formulated with dried mushroom

Treatments	Total plate counts (cfu/g)			Coliform groups (cfu/g)\			*Salmonella sp* (cfu/25g)		
	0 Mon	3 Mon	6 Mon	0 Mon	3 Mon	6 Mon	0 Mon	3 Mon	6 Mon
Chicken burger (Control) 0% dried mushroom	4.9×10^3	2.2×10^3	1.9×10^2	ND	ND	ND	ND	ND	ND
Chicken burger 10% dried mushroom	4.7×10^3	2.0×10^3	1.5×10^2	ND	ND	ND	ND	ND	ND
Chicken burger 20% dried mushroom	4.5×10^3	2.1×10^3	1.3×10^2	ND	ND	ND	ND	ND	ND
Chicken burger 30% dried mushroom	4.5×10^3	1.7×10^3	1.1×10^2	ND	ND	ND	ND	ND	ND

ND = not detected   Cfu = colony form unit

It could be concluded that, the chicken burgers prepared from chicken breast supplemented with dried mushroom, can be stored a frozen state at -18 ^{o}C without undesirable changes of microbial deterioration.

Conclusion

Finally, it could be concluded that dried mushroom can be used for food fortification as functional food in meat products. Dried mushroom improved the chemical, physical and organoleptic properties of chicken burger. It can reduce the coasts of chicken burger. Also, frozen mushroom chicken burger could be stored for 6 months without undesirable changes of microbial contamination.

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Journal of Home Economics, Volume 27, Number (2), 2017

التقييم الكيماوي والتكنولوجي والميكروبيولوجي لبرجرالدجاج المخلوط بفطر عيش الغراب المجفف

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تم القيام بهذه الدراسة لاعداد برجرالدجاج بالاحلال الجزئي بمسحوق فطرعيش الغراب. تم تقييم الخواص الحسيه، والتركيب الكيميائي وقيمة الطاقة الحرارية، والخواص الفيزيائية للبرجر المعد .وقداجري الاختبار الميكروبيولوجي اثناء التخزين بالتجميد على برجر الدجاج. الا ان اضافة ١٠ ، ٢٠ و٣٠ % منمسحوقالفطرالي خلطات برجر الدجاج لم يغير من الخواص الحسية وقبول المستهلكين. كما لوحظ انخفاض في التقييم الحسي للقوام والصلابة بشكل متزامن مع زيادةمستوىمسحوق الفطرالمستخدم. وعموما برجر الدجاج الذي تم اعداده باضافة ٣٠% مسحوق فطر عيش الغراب قد سجل اعلي محتوى في الرطوبة، الرماد، والالياف في كلا من البرجر الخام والمطهي بينما، سجل انخفاضا في قيمة البروتين ،الدهن، الكربوهيدرات، والطاقة الكلية. من ناحية اخرى حدثت زيادةمعنوية في الاحتفاظ بالدهن والماء ،ومستوى الطهي ، والقدره علي امتصاص الماء للبرجرالمحضر بأضافةمسحوق فطر عيش الغراب مقارنة بالكنترول. كماانخفضت قيمة الانكماش والفقد بالطهي مع زيادة نسبة الاحلال لمسحوق الفطر مقارنة بمعاملة الكنترول. بالنسبة للتقييم الميكروبيولوجي سجل العد الكلي للبكتيريا انخفاضا في كل المعاملات اثناءالتخزين بالتجميد وقد وجد ان المعاملات التي تحتوي علي مسحوق فطرعيش الغراب سجلت أعداد اقل. و لم يتم اكتشاف وجود مجموعة الكوليفورم والسلمونيلا في كل المعاملات اثناء التخزين بالتجميد.

الكلمات المفتاحية: برجر الدجاج، مسحوق عيش الغراب، التركيب الكيميائى، الخواص الطبيعية، صفات الطبخ، التقييم الميكروبيولوجى.