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لبحوث السوق وحماية المستهلك

Effect of partial replacement of beef meat with powdered of oyster mushroom *Pleurotus eryngii* (King oyster mushroom) on physical and sensory properties of meat burger.

Kifah S. Dosh **Nada N. Tawfiq**

Department of Food Science, College of Agriculture, University of Baghdad

Sajid O. Mohammed
Unit of Medicine and Aromatic Plant, College of Agriculture, University of Baghdad

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Abstract

The present study examined the effect of partial replacement for beef meat with Mushroom Powder (MP) in beef burger production. Beef meat was partially replaced by MP in ratios of (0, 10, and 15%). physical properties, and sensory evaluation were done at zero time and after 3 and 7 days of storage at 6 ± 1°C. The result showed that 15% of beef meat could be replaced with MP and still providing good quality of burger. also burger formulated with 15% MP significantly ($p \leq 0.05$) recorded the lowest reduction in diameter, thickness and weight loss during cooking (12.40, 3.57 and 11.11%) as compared with control (17.82, 19.81, 19.68%). The adding of MP has significantly increased the water holding capacity of manufactured burgers it was (33.93, 45.61 and 51.80%) for control, 10% and 15% substitute respectively. In the sensory evaluation, burger incorporated with 10 and 15% MP had the highest scores for all sensory attributes. the juiciness and tenderness of these burgers was improved, So that values of these parameters were increased with increasing of replacement percentage of meat comparing with control treatment. the present study suggested that incorporation of MP up to 15 % to replace beef meat improved flavor, juiciness, tenderness and acceptance.

Key word: Beef burger, Mushroom powder, physical properties sensory evaluation.

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تأثير الاستبدال الجزئي للحم العجل بمسحوق الفطر (king oyster mushroom) في الصفات الفيزيائية والحسية لأقراص لحم العجل.

كفاح سعيد دوش ندى ناجي توفيق ساجد عودة محمد

قسم علوم الاغذية، كلية الزراعة، جامعة بغداد وحدة النباتات الطبية، قسم البستنة والغابات، كلية الزراعة

الخلاصة

اجريت الدراسة الحالية لمعرفة تأثير الاستبدال الجزئي للحم العجل بمسحوق الفطر وبنسب هي صفر و 10 و 15% في الصفات الفيزيائية والحسية لاقراص اللحم المصنعة. اجري تقييم للصفات الحسية والفيزياوية بعد التحضير مباشرة وكذلك بعد مرور 3 و 7 ايام من الخزن على درجة حرارة 6 ± 1°م. اظهرت نتائج الدراسة الحالية ان استبدال اللحم بنسبة 15% من مسحوق الفطر ادى الى الحصول على اقراص لحم مصنعة ذات نوعية عالية. وامتازت النماذج التي احتوت على 15% من مسحوق الفطر على اقل نسبة تغير في القطر والسمك والوزن بعد التصنيع التي كانت بواقع (12.40، 3.75 و 11.11%) مقارنة مع نموذج السيطرة البالغة (17.82، 19.81 و 19.68%). وقد وجد ان لنسبة الاستبدال الاثر المعنوي في زيادة صفة قابلية حمل الماء البالغة (33.93، 45.61 و 51.80%) في نموذج السيطرة ونماذج الاستبدال بنسب 10 و 15% على التوالي. وعند اجراء التقييم الحسي للنماذج وجد ان استبدال اللحم بمسحوق الفطر حسن من صفات العصيرية والطراوة اذ ازدادت القيم بزيادة نسبة الاستبدال مقارنة مع معاملة السيطرة وكانت هذه الزيادة معنوية كما زادت قيم النكهة والتقبل العام وكانت الزيادة معنوية للاقراص المصنعة باضافة 10 و15%.

الكلمات المفتاحية: بيرلر اللحم، مسحوق الفطر، الصفات الفيزيائية، الصفات الحسية.

Introduction

Mushrooms have been broadly used as food or food ingredients in various food products for a long time. This fungus is cultivates on a decayed organic material and produce edible portion on the surface of the substrate. Dry matters of mushrooms contain more than 25% protein, less than 3% crude fat and almost 50% of total carbohydrate (13). Mushrooms are considered to be healthy because they are low in calories, sodium, fat and cholesterol level. Therefore, they form an important constituent of a diet for a population suffering from atherosclerosis (8). It also contain appreciable amount of dietary fibre and β-glucan, vitamin B groups, D and other useful nutrients.Oyster mushroom have a great potential, due to their a great nutritional value since they are quite rich in protein, with an important content of essential amino acids and fiber, and poor in fat. Edible mushrooms also provide a nutritionally significant content of vitamins (B1, B2, B12, C, D and E) (10; 11). 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, taking advantage of the additive and synergistic effects of all the bioactive compounds present (9: 17).The functions of mushroom include reducing cholesterol (3), lowering blood pressure, strengthening the immune system against diseases (19), combating tumors (14) and improving liver function (23). Freshly harvested oyster mushrooms were reported to contain high moisture content at more than 80% and low fat content in average ranged from 0.38% to 2.28%, indicated low calorific value (kcal) contribution of mushrooms on total daily energy intake (4). In aprevious study found that by replacing MF at 30% level informulation, substantial improvement in the protein and fiber contents can be achieved without affecting physical and sensory properties of burger (15). It is expected that by partially replacing beef meat with oyster mushroom powder into burger formulation, an improvement of nutritional composition especially dietary fiber without affecting sensorial properties can be achieved. Recently studied the colour, textural properties and cooking characteristics of chicken patty added with *Pleurotus sajor-caju* (PSC) (22). Thus, the present study was designed to evaluate the effects of Oyster mushroom flours added as various ratios (10 and 15%) on the cooking quality and sensory characteristics.

Material and methods

Sample preparation:

Beef meat obtained from the local market in Baghdad ,Fresh Oyster mushroom *Pleurotus eryngii* (King oyster mushroom) were obtained from Unit of Medicine and Aromatic Plant, College of Agriculture, University of Baghdad kept at 3–4°C until needed for technological studies.

Preparations of mushroom powder:

Oyster mushrooms were washed with cold water and blanched with steam for 7 min and dried in a thermostatically controlled oven with air fan to 60°C for 270 min and milled using a Laboratorial disc mill to pass through a 20 mesh/inch sieve, until using. However, steam blanching is necessary to remove the bitter taste from the mushrooms and to completely inactivated the polyphenol oxidase in mushroom (6).

Preparation of mushroom powder and beef meat blends:

Mushroom were milled and sieved to obtain the flour. Beef meat was well blended with mushroom powder to produce individual mixtures containing 0, 10 and 15% replacement levels by substituted the beef meat by Mushroom powder (MP). All samples were stored at 3–4°C until required.

Burger preparation:

Three treatments were prepared with three levels of MP 0, 10 and 15% as beef meat substitute called (C,T10 and T15). Burgers were prepared according to the procedure described by (21) with slight modifications. The percentages of all ingredients are unchanged compared with the control sample, whereas the percentage of beef meat decreases with the increase of MP content .The MP was incorporated into the beef meat using the formulations described in Table 1. The beef meat was manually cut using a cleaver and minced using a food processor. Starch, water, shortening, spices and Salt were also added to the minced beef and mixing was carried out using a Hobart mixer for 3 min. The finished beef burger were then weighed into 70 g portions and then manually molded to produce a uniform burger with the diameter and thickness of 100 and 10 mm, respectively. The beef burger were then packed in degradable plastic at 6 ± 1°C for 7 days until further analyses.

Table (1): Ingredients used in beef patty formulated with different level of mushroom powder.

Ingredients	Ground oyster mushroom level (%)		
	0	10	15
Beef meat	100	90	85
Fat	10	10	10
Water	25	25	25
Starch	10	10	10
Salt	1	1	1
Spices	10	10	10
Total	156	156	156

Cooking procedure:

Meat burger were thawed then cooked on a pan-fried electric skillet for 7-8 min until an internal temperature of 72± 1°C was achieved.

Physical characteristics of burger:

Loss in weight: measuring the weight of six burgers for each treatment and calculations of weight differences before and after cooking according to (9).

$$\text{Loss in weight (\%)} = \frac{\text{weight before cooked} - \text{weight after cooked}}{\text{weight before cooked}} \times 100$$

Diameter reduction (%) calculated by using the following equation:

$$\text{Diameter reduction (\%)} = \frac{\text{raw meat burger diameter} - \text{cooked meat burger diameter}}{\text{raw chicken patties diameter}} \times 100$$

Changed in thickness: measuring the thickness of six meat burgers for each treatment and calculations of thickness differences for burgers before and after cooking according to (9).

$$\text{Thickness reduction (\%)} = \frac{\text{raw meat burger thickness} - \text{cooked meat burger thickness}}{\text{raw chicken patties thickness}} \times 100$$

Water Holding Capacity (W.H.C): calculated according to (5) by mixing 50 g of burger with 50 g of water for 1 min ,homogenized by blender then the mixture centerfugied at (5000g\min) for 10 min, water holding capacity calculated by using the following equation

$$\text{Water holding capacity \%} = \frac{\text{Water weigh before centrifugation - Water weigh after centrifugation}}{\text{sample weight}} \times 100$$

Proximate analysis:

Proximate analyses for fresh and dried mushroom were conducted using(1) for moisture, ash, fiber, protein by 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– (g moisture + g protein + g fat + g ash).

Sensory evaluation:

All samples were evaluated by each untrained consumers according to the hedonic scaling method outlined by Sensory evaluations were carried out according to (2). by staff of the food Sciences department, University of Baghdad. The cooked burger samples were equally divided into 6 portions. They evaluated samples for aroma, colour, springiness, juiciness, flavor and overall acceptance on a 10 degree for each characters.

Statistical Analysis: The Statistical Analysis System- SAS (20) program was used to effect of treatments in study parameters . Least significant difference (LSD) test was used to significant compare between means.

Results and discussion:

Nutrient and chemical composition of Oyster Mushroom:

The nutrient and chemical composition for fresh and dried mushroom *Pleurotus eryngii* (King oyster mushroom) are shown in (Table, 2).

Tabe (2): Chemical composition for wheat flour, fresh and dried mushroom.

sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)	Total dietary fibers (TDF) (g/100g)
Fresh mushroom	**89.20**	**1.31**	**0.15**	**0.70**	**8.64**	**3.0**
Dried mushroom	**12.50**	**28.80**	**3.00**	**3.50**	**52.20**	**34.5**

Freshly harvested oyster mushrooms were content 89.00, 1.31, 0.15, 0.70 and 8.64% moisture, protein, fat ash and carbohydrate respectively this results consistent with the results found by(4; 7) found that fresh mushroom contain high moisture content at more than 80% and low fat content in average ranged from 0.38% to 2.28%, indicated low calorific value (kcal) contribution of mushrooms on total daily energy intake. Meanwhile dried mushroom which used in this study contained protein concentration of 28.8%, This value is close to the percentage range with those reported previously by (7), They discovered that the protein content of various selected dried mushroom ranged from 23.4 to 43.5%. The fat concentration in oyster mushroom used in the present study is 3.0%. This value is close to the fat content of enokitake mushroom *(Flammulina velutipes)* which had 3.7% fat (7). The total ash content was recorded in oyster mushroom used in this study is 3.50%. Apart from that, dried oyster mushroom contained 34.5 g/ 100 g of TDF The present results were in agreement with the dietary fiber content of the fruiting body of other mushroom species which ranged from 30-40% dry weight (16).

The physical properties of burger:

Physical traits of cooked beef patties incorporated with MP was studied. The percentage of loss in weight during cooked beef burger incorporated with different level of oyster mushroom and control treatment are presented in (Table, 3).

Table (3): The changes in meat burger weight formulated with different level of MP during cooking.

Replacement%	Time of storage at 6 ± 1°C (day)		
	0	3	7
C	19.68	20.21	22.46
T10	14.09	15.30	16.31
T15	12.40	13.61	15.01
L.S.D	*3.683	*3.704	*4.255

(P < 0 .0 5) *

The results in tab 2 showed a significant reduction in percentage of loss in weight during cooking with increasing in substituting percentage of pure beef meat by MP in burger formulations. At zero time (burger don't storage) It was (19.68,14.09 and 12.40%) for C ,T10 and T15 respectively, while the percentage of weight loss became (20.21, 15.30 and 13.61%) for samples of burger which stored for 3days at 6 ± 1°C before cooking and (22.46, 16.31 and 15.01%) for samples of burger which stored for 7days at 6 ± 1°C before cooking. The results reveled that burger formulated with oyster mushroom showed a decrease ($P < 0.05$) in weight loss during storage . This is consistent with what was said (12) about the low percentage loss during cooking when using vegetable additives in the manufacture of burger .The loss in weight could be attributed to the high loss of moisture during cooking specially in control treatment. There were an inverse relationship between moisture retention and cooking yield with the level of mushroom used in the burger patty formulations. This is probably due to the inability of fresh oyster mushroom fiber to create a tridimensional matrix within the patties. Tab 3 shows the effects of MP addition on The percentage of change in diameter of beef patties The results refer to a significant decreased in diameter changes with increased in replacement pure beef meat by MP.

Table (4): The changes in diameter of meat burger formulated with different level of MP during cooking.

Replacement%	Time of storage at 6 ± 1°C (day)		
	0	3	7
C	17.82	18.29	19.20
T10	6.09	6.23	6.62
T15	3.57	3.61	3.73
L.S.D	* 4 .6 8 2	* 3 .3 0 5	* 3 .9 2 1

(P < 0 .0 5) *

The highest value in diameter reduction in control treatment and the lowest value in treatment which meat beef substituted by 15% MP , at zero time for fresh burger it was (17.82, 6.09 and 3.57%) for control, T10 and T15 respectively while in samples which stored for 3 day at (6 ± 1°C) it was 18.29,6.23 and 3.61% and in samples which storage 7 days at the same temperature 19.20,6.62 and 3.73%.

(Table, 5) illustrated the changes in burger thickness after cooking ,the results refer to that the thickness influenced by MP incorporation the reduction in thickness of beef patty during cooking decreased proportionally with the level of MP in the formula. Oyster mushroom-based patties 15% substitute recorded lowest in reduction of thickness for all period of storage (11.11, 11.63 and 11.84)% and are significantly lower (P<0.05) than control patty which recorded (19.81, 22.42 and 26.34)% for the same period of storage.

Table (5):The changes in thickness of meat burger formulated with different level of MP during cooking.

Replacement(%)	Time of storage at 6 ± 1°C (day)		
	0	3	7
C	19.81	22.42	26.34
T10	14.62	15.04	15.70
T15	11.11	11.63	11.84
L.S.D	*4.092	4.572*	*5.614

(P < 0 .0 5) *

The results of water holding capacity of beef patties formulated with MP illustrated in tab 5 it was similar with the trend of the loss in weight during cooking result in tab 3. The results showed that the substituted beef meat by MP significantly effected in increasing the water holding capacity, and this properties increased with the increased in percentage of MP this explains the reduced loss in weight during cooking patty. The reason may be due to the ability of plant proteins to hold the water and formation a network with it as functional properties **(**18**).** Oyster mushroom-based patties 15% substitute recorded highest in water holding capacity for all period of storage (51.80, 52.54 and 53.30) % and are significantly higher (P<0.05) than control patty which recorded (33.93, 31.31 and 27.22) % for the same period of storage this results consist with results found by (21).

Table (6): The changes in water holding capacity of meat burger formulated with different level of MP during cooking.

Replacement%	Time of storage at 6 ± 1°C (day)		
	0	3	7
C	33.93	31.31	27.22
T10	45.61	47.25	48.95
T15	51.80	52.54	53.30
L.S.D	* 6.266	* 7.861	* 6.258

(P < 0 .0 5) *

Sensory evaluation:

(Table, 7) shows the effects of substituted beef meat by MP on the flavor, juiciness, tenderness and acceptant of beef patties. Generally, all properties attributes investigated were influenced by MP substituted percentage. The juiciness and tenderness of these patties was improved, So that values of these parameters were increased with increasing of replacement percentage of MP comparing with control treatment. The scores of flavor and sensory evaluation were increased in these treatments compared with control, The juiciness of beef patty increased proportionally with the level of MP. MP-based patties 10% recorded juiciness ranging from (8.50- 8.25) through 7 days of storage and 15% ranged (7.75-7.5) which are significantly higher ($P<0.05$) than control patty which recorded (8.00- 4.00) through 7 days. The tenderness of beef patties was also increased proportionally with the level of MP. Beef patty prepared without MP (control) was (8.00- 5.00) lower compared to beef patties prepared with 10% (9.50-9.00) and 15% (9.50- 9.25) MP. This increased in juiciness , tenderness could be attributed to the higher in water holding capacity of oyster mushroom . Similar trend was also recorded in acceptant addition of MP in beef patties increased the acceptant of treatments patty. The acceptant for control recorded (8.50- 5.00) significantly ($P<0.05$) lower than the acceptant properties of burger s with 10% of MP (8.75- 8.00) and within 15% MP ranged (9.00- 8.00). From the above results we conclude that the adding of MP was improved the quality of processed product and give the best results without undesirable changes in physical and sensory properties, moreover that we can replace MP instead of beef meat in processed meat patties to reduce of red

meats,which consider as healthy additives for consumer who suffer from high concentration of cholesterol in blood.

Table(7): Sensory evaluation of meat burger formulated with different level of MP during cooking.

Characters	Replacement(%)	Storage time (day)		
		0	3	7
flavor	0	9.00	7.00	6.00
	10	9 .0 0	9 .0 0	8 .5 0
	15	8 .5 0	8 .2 5	8 .0 0
LSD	-------	1 .9 2 NS	1 .5 6*	1 .0 8*
juiciness	0	8.00	6.00	5.00
	10	8.50	8.25	8.25
	15	7.75	7.50	7.50
LSD	-------	1 .1 5 NS	1 .1 5*	1 .5 5*
Tenderness	0	8.00	6.00	5.00
	10	9.50	9.50	9.00
	15	9.50	9.25	9.25
LSD		0 .5 0*	0 .8 5*	0 .7 9*
acceptant	0	8.50	7.00	6.00
	10	8.75	8.00	8.00
	15	9.00	8.25	8.00
LSD		0 .7 5*	0 .8 2*	1 .0 0*
(P < 0 .0 5) * NS=non significant				

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