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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

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Abstract: The chemical, physical, and sensory evaluation of buffalo meat patties was evaluated in order to study the effect of adding low fat soy flour and/or mung bean powder as meat extenders. The results indicated that using low fat soy flour or mung bean powder as meat extenders at a level of 10% reduced the moisture and fat content, whereas increased the fiber and protein contents in the cooked samples. The reduction was greatest in the control (100% buffalo meat), and lowest in the sample containing 5% of both low fat soy flour and mung bean powder. The cooking treatment increased the expressible water for the control and 10% low fat soy flour samples, and increased the protein water coefficient for all samples. The Feder value for sample containing 5% of both low fat soy flour and mung bean powder was similar to the control one. The addition of mung bean powder increased the water holding capacity, whereas the addition of low fat soy flour and mung bean powder as meat extenders decreased the cooking loss in the formulated patties. The lowest value was in the sample containing 5% of both extenders. Samples containing 5% of both low fat soy flour and mung bean powder had the highest water retention value, whereas the sample with 10% low fat soy flour had the highest fat retention value. Samples containing 5% of both low fat soy flour and mung bean powder had the highest values for color, taste, odor, juiciness, and overall acceptability among the other samples.

Key words: mung bean, low fat soy flour, meat extenders, buffalo meat product, physical and sensory quality

Introduction

Protein is one of the five basic components in an adequate diet. Because of projected shortages of food proteins throughout the world, it is expected that plant materials will play an increasing role in supplying proteins for human as well as animal consumption.

Legumes are considered excellent sources of good quality protein; they offer a partial solution of this problem *(Aruna and Prakash, 1993; Liu, 2000; Khalid et al., 2003; Khalil, 2006)*. Since legumes seeds are important sources of protein, complex carbohydrate and dietary fiber in the diet, there has been a worldwide interest in searching for potential utilization of unconventional legumes.

Researchers have evaluated a myriad texture modifying ingredients, such as plant proteins, gums, starches, and fiber in an effort to improve the sensory properties of low-fat ground beef *(Anderson and Berry, 2000)*. High fat intake is associated with increased risk for obesity and some types of cancer. However, saturated fat intake is associated with high blood cholesterol and coronary heart disease *(Astrup et al., 2000)*.

Non meat ingredients are useful in emulsified meat products because of their functional properties such as emulsification of both texture and appearance. *Troy et al. (1999)* studied the use of tapioca starch, carrageenan, oat fiber, pectin and whey protein as replacers in low fat beef burger. The samples were tested for cooking yield, water holding capacity, retention of shape, sensory and mechanical texture analysis.

Many plant proteins usually in the form of protein extracts, or as is, are being tested for new products, such as low cost fabricated foods which are nutritious, attractive and acceptable to consumers just like conventional foods from meat, fish and dairy products *(Rosario and Flores, 1981)*.

Soy is a more common ingredient found in finished meat and poultry products. With the continuing rise in meat prices, soy products in meat applications are gaining additional interest.

Ho et al. (1997) used dried soy tofu powder in the formulation of frankfurters and pork sausage patties. The results indicated that regular frankfurters treated with soy tofu powder had low fat content and no significant differences were found in color, texture or overall acceptability. *Lin and Mei (2000)*, studied the effect of sodium alginate and soy protein isolate on the textural and physicochemical properties of reduced fat meat emulsion. They found that the addition of gums and soy protein isolate could improve the emulsion stability by reducing the water loss and increasing the water holding capacity compared to the control.

Mung bean is an excellent source of high quality protein and one of the cheapest and richest sources of plant protein which is commonly used in many products. Ground mung bean may be used as a substitute or in combination with other ingredients in many food products.

The objective of this investigation was to use the low fat soy flour and mung bean powder as meat extenders, and study the effect of this replacement on the chemical, physical, and sensory quality of buffalo meat product.

Materials and Methods

Preparation of buffalo meat products: The buffalo meat (bottom round) used in this study was obtained from a local market in El-Minia, Egypt, one hour after slaughter. The sample was trimmed, packaged in low density polyethylene bags and held at 4±1°C for 24 hours, cut into cubes and minced with a meat grinder using 8 mm (coarse) and 3 mm (fine) plates simultaneously to obtain ground buffalo meat.

Hesco low fat soy flour was obtained from Hesco, Watertown, South Dakota, USA. Whereas, mung bean was obtained from a local market in El-Minia, then crushed, removed the husk, and ground in an electric grinder in order to get 80 mesh powder.

Buffalo meat products were prepared according to the following recipe in (Table 1). All the ingredients in each formula were mixed well and divided into 50 g balls, then formulated in patties like shape (10 cm diameter, and 0.5 cm thickness).

Analytical methods:

1-Chemical composition: Moisture, crude protein, crude fat, ash, and fiber contents were determined according to the methods of the *(AOAC, 1995)* for the raw materials and the final product before and after cooking. Available carbohydrates were calculated by difference.

2- Physical analysis:

a- Expressible water (EP) was determined according to *Alvarez et al. (1992)*, whereas, the water holding capacity (WHC) was calculated.

b- The cooking loss was determined according to *Abd El-Hamied (1996)* by weighing the samples before and after cooking in hydrogenated oil at 150°C for 2 minutes for each side.

c-The shrinkage value of cooked patties was determined according to the method of *Adams (1994)*.

d-Percentage of water and fat retention of all formulated buffalo meat patties were calculated according to the method of *Ronald et al. (1981)*.

e- Texture coefficient indices (protein water coefficient PWC, and protein water fat coefficient PWFC), for the formulated buffalo meat patties were calculated according to the methods described by *Tsoladze (1972)*.

f- Feder value for the samples was calculated according to the method of *Pearson (1991).*

Table 1. Composition of control and formulated patties, %

Ingredients	Control 100% buffalo meat	10% low fat soy flour	10% mung bean powder	5% low fat soy flour + 5% mung bean powder
Ground buffalo meat	84	69	68	70
Fat tissue	10	10	10	10
Salt	2	2	2	2
Black pepper	1	1	1	1
Onion	1	1	1	1
Crushed ice (water)	2	8	9	8
low fat soy flour	0	9	0	4.5
Mung bean powder	0	0	9	4.5

3- Sensory evaluation: Sensory evaluation for color, taste, odor, juiciness, and overall acceptability for the cooked formulated buffalo meat patties were carried out in order to determine the consumer acceptability for the product according to the methods described by *Larmond (1977).* Ten judges participated in this test. A numerical hedonic scale ranged between 1 and 10 (1 for very bad, and 10 for excellent) was used for sensory evaluation.

4- Statistical analysis: Data were analyzed by analysis of variance (ANOVA) to determine if treatments were significantly different according to *Gill (1981).*

Results and Discussion

Tables 2 and 3 illustrated the chemical composition of raw materials and formulated buffalo meat patties before and after cooking. The data showed that using low fat soy flour or mung bean powder as meat extenders at level of 10% significantly reduced ($P \leq 0.05$) the moisture, and fat contents, and significantly increased ($P \leq 0.05$) the fiber, and the protein contents in the cooked samples. Whereas, using 5% of each flour increased the moisture content.

Table 2. Chemical composition of meat, low fat soy flour and mung bean powder *

Component%	Ground buffalo meat		Low fat soy flour		Mung bean powder	
	Wet weight	Dry weight	Wet weight	Dry weight	Wet weight	Dry weight
Moisture	70.41 ± 0.07	0.00	7.04 ± 0.05	0.00	7.58 ± 0.03	0.00
Protein**	17.87±0.43	58.33±0.46	48.40±0.38	52.04±0.32	23.56±0.18	25.71±0.63
Crude fat	9.50 ± 0.06	31.35 ± 0.06	2.28 ± 0.01	2.45 ± 0.01	1.91 ± 0.02	2.06 ± 0.03
Ash	1.01 ± 0.00	3.40 ± 0.00	5.91 ± 0.05	6.36 ± 0.05	3.27 ± 0.07	3.54 ± 0.07
Fibers	0.00 ± 0.00	0.00 ± 0.00	3.00 ± 0.03	3.46 ± 0.04	1.81 ± 0.01	1.96 ± 0.01
Carbohydrates***	0.00	0.00	33.37±0.43	35.61±0.18	61.87±0.32	66.73±0.25

* Means of three determinations ± Standard Deviation. **Total nitrogen ×6.25.
*** Calculated by difference.

Table 4. showed the effect of meat extenders and cooking treatment on some physical parameters of formulated patties. The data showed that all samples experienced a reduction in weight, thickness, and diameter as a result of the cooking treatment. The reduction was significantlz high ($P \le 0.05$) in the control sample, and significantly low ($P \le 0.05$) in the 5% of both low fat soy flour and mung bean powder sample.

The effect of meat extenders and cooking on the expressible water, the protein-water-coefficient (PWC), the protein-water-fat-coefficient (PWFC), and Feder value of formulated patties was shown in Table 5. The data showed that the cooking treatment significantly increased ($P \le 0.05$) the expressible water values for control and 10% low fat soy flour samples, whereas, significantly decreased ($P \le 0.05$) for the samples containing mung bean powder. The cooking treatment increased the (PWC) for all samples. The increment was the highest for samples containing 10% low fat soy flour or mung bean powder, and the lowest for the sample containing 5% of both low fat soy flour and mung bean powder. The Feder value was one of the tests used for assessing the quality of meat products. The data illustrated that Feder value for sample (cooked) containing 5% of both low fat soy flour and mung bean powder was similar to the control one.

Table 3. Chemical composition of control and formulated patties*

Component%	Control 100% buffalo meat		10% low fat soy flour		10% mung bean powder		5% low fat soy flour + 5% mung bean powder	
	Raw	Cooked	Raw	Cooked	Raw	Cooked	Raw	Cooked
Moisture	70.32±0.05	51.94±0.18b	65.76±0.09	50.74±0.62a	65.89±0.06	50.24±0.49a	63.52±0.04	54.03±0.97c
Protein**	14.86±0.17	24.06±0.21b	18.16±0.32	25.17±0.51c	16.52±0.18	24.80±0.41c	17.32±0.21	20.07±0.32a
Crude fat	12.87±0.03	20.80±0.17c	12.28±0.05	17.67±0.57a	11.62±0.02	16.95±0.23a	11.85±0.03	18.18±0.65b
Ash	1.82±0.03	2.42±0.08a	2.13±0.02	2.62±0.10b	1.91±0.03	2.26±0.04a	1.99±0.02	2.63±0.10b
Fibers	0.14±0.01	0.25±0.01a	0.41±0.01	0.61±0.01c	0.30±0.01	0.44±0.01b	0.35±0.00	0.45±0.01b
Carbohydrates***	00	00	1.26±0.11	3.19±0.20a	3.76±0.18	5.31±0.11b	4.97±0.10	4.64±0.21b
Energy (Kcal/100g)	175	283	188	272	185	270	196	262

* Means of three determinations ± Standard Deviation. **Total nitrogen ×6.25. *** Calculated by difference.
Means of the same letters in rows are not significantly different at 5% level of significance.

Table 4. Weight, thickness and diameter of control and formulated patties*

Parameters	Control 100% buffalo meat		10% low fat soy flour		10% mung bean powder		5% low fat soy flour + 5% mung bean powder	
	Raw	Cooked	Raw	Cooked	Raw	Cooked	Raw	Cooked
Weight (g)	50.00 ± 0.00	30.02 ± 0.41a	50.00 ± 0.00	35.02 ± 0.06b	50.00 ± 0.00	34.02 ± 0.31b	50.00 ± 0.00	40.02 ± 0.55c
Thickness (cm)	0.50 ± 0.00	0.40 ± 0.00a	0.50 ± 0.00	0.40 ± 0.00a	0.50 ± 0.00	0.40 ± 0.00a	0.50 ± 0.00	0.40 ± 0.00a
Diameter (cm)	10.00 ± 0.00	7.30 ± 0.08a	10.00 ± 0.00	7.30 ± 0.08a	10.00 ± 0.00	7.25 ± 0.04a	10.00 ± 0.00	7.40 ± 0.08b

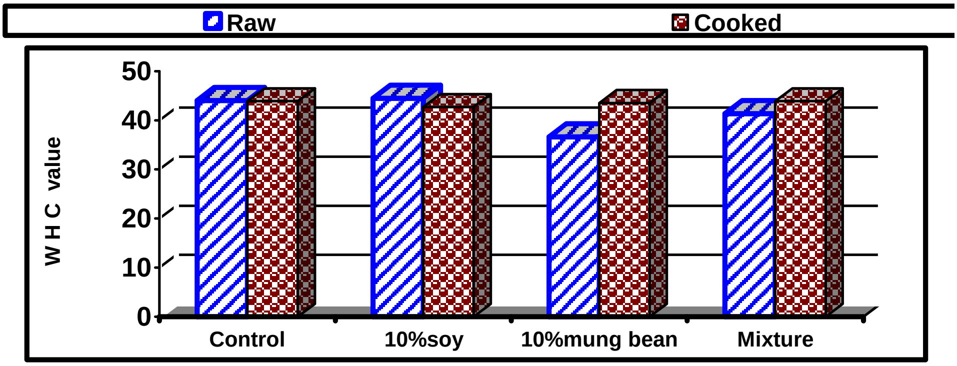
* Means of three determinations ± Standard Deviation.
Means of the same letters in rows are not significantly different at 5% level of significance.

Table 5. Effect of buffalo meat extenders and cooking on some physical parameters of control and formulated patties*

Parameters	Control 100% buffalo meat		10% low fat soy flour		10% mung bean powder		5% low fat soy flour + 5% mung bean powder	
	Raw	Cooked	Raw	Cooked	Raw	Cooked	Raw	Cooked
Expressible water	55.96±0.38a	56.12±0.85ab	55.51±0.82a	57.28±0.82ab	63.36±0.82c	56.48±0.12ab	58.62±0.96bc	56.12±0.23ab
PWC %	0.21±0.01a	0.46±0.09d	0.28±0.11b	0.50±0.10e	0.25±0.08a	0.49±0.03e	0.27±0.01b	0.37±0.08c
PWFC %	0.81±0.01e	0.30±0.02c	0.23±0.02a	0.37±0.03d	0.21±0.01a	0.37±0.01d	0.23±0.02a	0.28±0.03b
Feder value	4.69±0.08d	2.09±0.03b	3.32±0.15c	1.75±0.03a	3.20±0.12c	1.64±0.05a	2.81±0.10b	2.15±0.06b

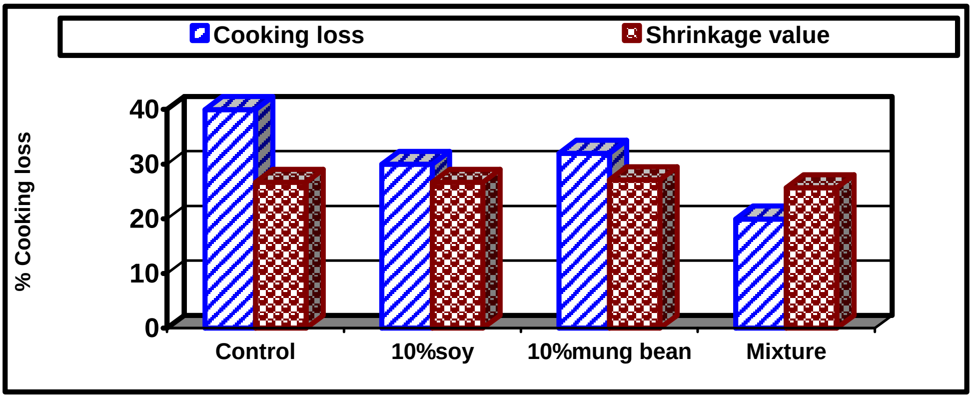
* Means of three determinations ± Standard Deviation.
PWC = protein water coefficient, PWFC = protein water fat coefficient
Means of the same letters in rows are not significantly different at 5% level of significance.

Figures 1 and 2, illustrated the effect of meat extenders and cooking treatment on the water holding capacity (WHC) and cooking loss of formulated patties. The data showed that addition of mung bean flour increased the WHC value for cooked samples compared to uncooked ones. This gives the impression that mung bean increased the ability of water retention and the tenderness of the product.



Control = 100% buffalo meat. 10% soy = 10% low fat soy bean flour. 10% mung bean = 10% mung bean powder. Mixture = 5% low fat soy bean flour + 5% mung bean powder.

Figure 1. Effect of meat extenders and cooking on the water holding capacity of formulated patties

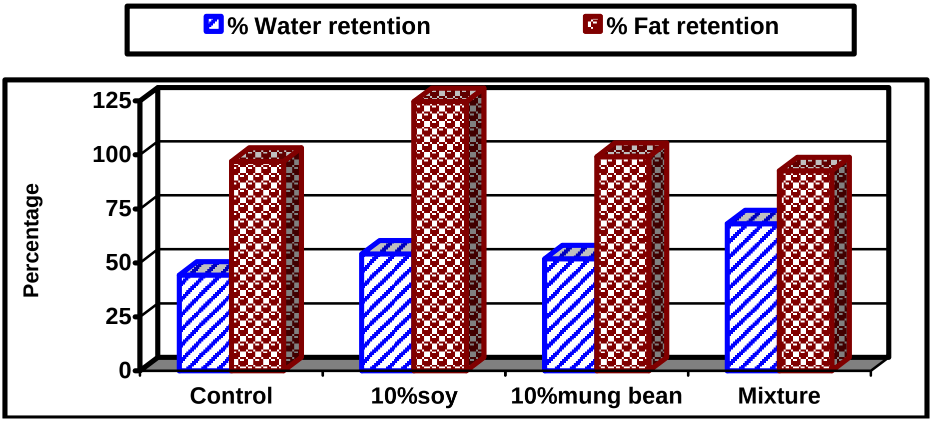


Control = 100% buffalo meat. 10% soy = 10% low fat soy bean flour. 10% mung bean = 10% mung bean powder. Mixture = 5% low fat soy bean flour + 5% mung bean powder.

Figure 2. Effect of meat extenders and cooking on the cooking loss and shrinkage value of formulated patties

The results also showed that the addition of low fat soy flour and mung bean powder as meat extenders decreased the cooking loss in the formulated patties. The lowest cooking loss values were obtained in samples containing 5% of both low fat soy flour and mung bean powder, whereas, the highest values were obtained in the control ones.

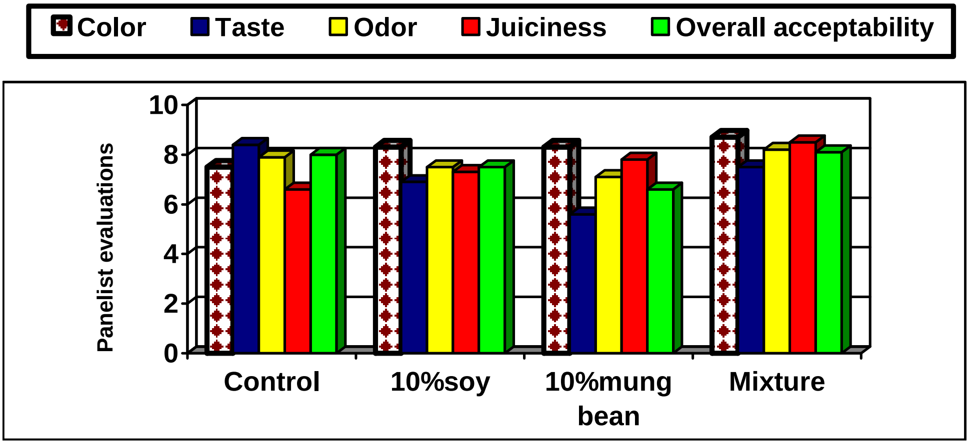
Figure 3 illustrated the effect of meat extenders on water retention and fat retention of formulated patties. The results indicated that the sample containing 5% of both low fat soy flour and mung bean power had the highest water retention value, while the control sample had the lowest. This comes parallel to the results of cooking loss. The sample with 10% low fat soy flour had the highest fat retention value, while 5% of both low fat soy flour and mung bean powder sample had the lowest value.



Control = 100% buffalo meat. 10% soy = 10% low fat soy bean flour. 10% mung bean = 10% mung bean powder. Mixture = 5% low fat soy bean flour + 5% mung bean powder.

Figure 3. Effect of meat extenders and cooking on the water retention and fat retention of formulated patties

The sensory evaluation of formulated patties was illustrated in Figure 4. The data showed that the sample containing 5% of both low fat soy flour and mung bean power had the highest values for color, taste, odor, juiciness, and overall acceptability among the other samples. Addition of low fat soy flour and mung bean powder as meat extenders increased the juiciness of the patties, whereas, samples contained 10% mung bean powder had the lowest values for taste, odor, and overall acceptability.



Control = 100% buffalo meat. 10% soy = 10% low fat soy bean flour. 10% mung bean = 10% mung bean powder. Mixture = 5% low fat soy bean flour + 5% mung bean powder.
Figure 4. Sensory evaluation of formulated patties

Conclusion

Use of cheap legumes (low fat soy flour and mung bean powder) as meat extender increased the nutritional value (by increasing protein and fiber content and decreasing the fat content) of the buffalo meat product. In addition it enhanced the physical quality of the formulated patties by increasing the water holding capacity, and decreasing the cooking loss.

Efekat dodavanja mlevenog kineskog pasulja i obezmašćenog sojinog brašna prerađevinama od mesa bivola na njihove hemijske, fizičke i senzorske osobine

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Rezime

Hemijska, fizička i senzorna ocena pašteta od bivoljeg mesa je urađena kako bi se ispitao uticaj dodavanja sojinog brašna niskog sadržaja masti i mlevenog kineskog pasulja kao delimične zamene mesa.

Rezultati su pokazali da je korišćenje obezmašćenog brašna soje ili mlevenog kineskog pasulja kao dodatka na nivou od 10% uticalo na smanjenje sadržaja vlage i masti, ali povećanja sadržaja vlakana i proteina u kuvanim uzorcima. Najveće smanjenje je utvrđeno u kontroli (100% bivolje meso), a najniže u uzorku koji je sadržavao 5% sojinog brašna i mlevenog kineskog pasulja.

Tretman kuvanjem je povećao količinu slabo vezane vode u kontroli i uzorcima sa 10% sojinog brašna sa niskim sadržajem masti, i povećao odnos protein voda u svim uzorcima. Federova vrednost za uzorak koji sadrži 5% sojinog brašna niskog sadržaja masti i mlevenog kineskog pasulja je bila slična vrednosti utvrđenoj u kontrolnim uzorcima.

Dodavanje mlevenog kineskog pasulja je uticalo na povećanje sposobnosti vezivanja vode, dok je dodatak obezmašćenog brašna soje i mlevenog kineskog pasulja kao dodatka uticao na smanjenje kala kuvanja u paštetama. Najniža vrednost je utvrđena u uzorku koji je sadržavao 5% oba dodatka. Uzorci koji su sadržavali 5% i brašna nemasne soje i praha kineskog pasulja su imali najveću vrednost zadržavanja vode, dok su uzorci sa 10% brašna soje sa niskom sadržajem masti imali najveću vrednost zadržavanja masti.

Uzorci koji su sadržavali 5% obezmašćenog brašna soje i mlevenog kineskog pasulja su imali najveće vrednosti za boju, ukus, miris, sočnost i ukupnu prihvatljivost od svih uzoraka.

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