*Full Length Research Paper*

# "Impact of dark bean (*Vigna mungo*) on the quality characteristics of oven-roasted chicken *seekh kababs*"

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The study was aimed at optimizing the basic formulation and processing conditions for the preparation of chicken *seekh kababs* from spent hens meat by oven roasting method of cooking and their extension with black bean paste (hydrated 1:1 w/w). Three levels of black bean paste viz. 10, 15 and 20% were used as extender replacing lean meat in the formulation. The chicken *seekh kababs* formulated without black bean served as control and were compared with *kababs* extended with different levels of black bean for various physicochemical and sensory properties. pH, emulsion stability and cooking yield increased significantly (P < 0.05) with increase in the extension level with highest value for the *kababs* extended with 20% black bean. All the proximate parameters that is, moisture, protein and fat percent except ash content decreased significantly (P < 0.05) with the increasing extension level for both raw as well as cooked *kababs*. Scores for all the sensory parameters except for appearance decreased significantly (P < 0.05) with increase in the level of extension. All the sensory parameters of the *kababs* extended with 10% black bean were comparable with control. Sensory scores and physicochemical properties indicated that 10% black bean paste was optimum extension level for the formulation of extended chicken *seekh kababs*.

**Key Words:** *Seekh kababs*, *vanaraja*, black bean, oven-roasting, quality parameters.

## INTRODUCTION

*Seekh kababs* are one of the popular convenient ready to eat meat products usually prepared from lamb and beef, though particular styles of *seekh kababs* can be made from meat of other animals like chicken, fish etc. These can be prepared in versatile forms suitable to different food patterns and cooking styles with several types of seasonings and flavourings. These are easy to prepare, take least time for cooking, have a unique flavour and taste, and can be served to a large number of customers in a relatively short period of time. Thus, *seekh kababs* come under the category of fast foods. But the cost of these products is high to be affordable to all the sections of society. Thus, its economic formulation keeping the

sensory attributes to acceptable limit is a challenge and as such the addition of low cost non-meat proteins (like black bean) to stretch the availability of *seekh kababs* is an important research area.

The increased concern for nutritional security of common mass demands a holistic approach to stretch the availability of quality protein sources by reducing the cost of formulated products. Poultry industry, a vibrant, organized and scientific sector now days, can play a key role in ensuring quality animal proteins at cheaper rate particularly through culled and spent hen meat. Processing of meat from spent hen to different value added products open the avenues for not only its

judicious utilization but a readily accessible animal protein sources for poor. Furthermore, the raising cost of broiler and mutton coupled with increased availability of spent hens has increased the development of meat products based on low cost meats and meat replacers.

Spent hens are old and culled chickens, which have completed their productive and reproductive phase of life and are considered as byproduct of egg industry (Mahapatra, 1992). Their meat is considered poor because of higher toughness and less juiciness which are due to high collagen content (Abe et al., 1996) and high degrees of cross linkages (Wenhen et al., 1973; Bailey, 1984) as compared to broiler meat. Problem of poor utilization can be resolved by development of further processed convenience products (Kondaiah, 1990; Chowdhuri et al., 1992) such as sausages, patties, kababs, rolls, steaks, nuggets, blocks etc. But the products prepared from spent hen meat have comparatively poor sensory properties and lower yield. The emulsion with inferior emulsifying capacity due to high proportion of connective tissue and less salt soluble proteins (Huspeth and May, 1969), higher cooking loss because of high fat content and poor water binding capacity (Acton and Dick, 1978; Buyck et al., 1982), low emulsion stability due to low concentration of salt soluble proteins (Hargus et al., 1970) are the shortcomings of using spent hens meat that can be overcome by suitable food additives or extenders like starch and milk proteins (Chung et al., 1989; Tarte et al., 1989).

Non- meat proteins from a variety of plant sources such as soy proteins (Gujral et al., 2002; Pietrasik and Duda, 2000; Porcella et al., 2001), buck wheat protein (Bejasano and Corke, 1998), samh flour (Elgasim and Al-wesali, 2000), common bean flour (Dzudie et al., 2002) and bengal gram and green gram (Modi et al., 2003; Bhat and Pathak, 2009) and corn flour (Serdarouglu and Degirmencioglu, 2004) have been used as binders and extenders in comminuted meat products. Stability, yield, textural palatability and cost of meat products are the major criteria for non-meat proteins (Roberts, 1974). Legumes provide energy, proteins, minerals, vitamins and the most important that is, dietary fibre required for human health. Several studies have proved that dietary fibers have the potential to reduce blood low density lipoprotein cholesterol (Brown et al., 1999), risk of diabetes mellitus type 2 (Willet et al., 2002), coronary heart disease (Bazzano et al., 2003), blood pressure (Streppel et al., 2005), obesity (Liu, 2003) and colorectal cancer (Schatzkin et al., 2007). Inclusion of legumes in daily diet has many physiological effects in controlling and preventing various metabolic diseases such as coronary heart disease and colon cancer (Tharanathan and Mahadevamma, 2003).

A very few workers have attempted the still inconclusive studies on the legumes as extenders in seekh kababs . Thus, the present study was envisaged to evaluate the effects of black bean on the quality characteristics of chicken seekh kababs.

## MATERIALS AND METHODS

### Source of chicken meat

Vanaraja birds (irrespective of sex) of the age group of over 80 weeks were purchased from State Animal Husbandry Department. The birds were slaughtered using ritual Halal method. The body fat was trimmed and deboning of dressed chicken was done manually removing all tendons and separable connective tissue. The lean meat was packed in polythene bags and frozen at –20°C until use.

### Condiments and refined wheat flour

Onion, garlic and ginger in the ratio of 3:2:1 were ground in a mixer to the consistency of fine paste. Refined wheat flour was purchased from local market and used.

### Spice mixture

The spice mix formula used by Kumar and Sharma (2005) was followed and is presented in Table 1.The spices were purchased from local market. After removal of extraneous matter, all spices were dried in an oven at 50°C for overnight and then ground in grinder to powder. The coarse particles were removed using a sieve (100 mesh) and the fine powdered spices were mixed in required proportion to obtain spice mixture for chicken kababs. The spice mixture was stored in plastic airtight container for subsequent use.

### Extender

Black bean also referred to as urad dal or bean, black matpe bean, black lentil, or white lentil (Vigna mungo), is a bean grown in southern Asia. The black bean was obtained from local market and converted to paste form after overnight soaking (1:1 w/w hydration). The paste of pulse was incorporated at 10, 15 and 20% levels in the formulation replacing lean meat.

### Fat

Refined cottonseed oil of brand name 'Ginni' was purchased from local market and used. The approximate composition of the oil is presented in Table 2.

### Preparation of seekh-kababs from meat of spent hen

Lean meat from spent hen was cut into smaller chunks and minced in a Sirman mincer (MOD-TC 32 R10 U.P. INOX, MARSANGO, ITALY) with 6 mm plate followed by common grind size, the 4 mm plate. The common salt, vegetable oil, refined wheat flour (maida), nitrite, sodium tripolyphosphate, spice mixture and condiment mixture were added to weighed meat according to formulation. Meat emulsion for chicken kababs was prepared in Sirman Bowl Chopper (MOD C 15 2.8G 4.0 HP, MARSANGO, ITALY). Minced meat was blended with salt, sodium tripolyphosphate and sodium nitrite for 1.5 min. Water in the form of crushed ice was added and blending continued for 1 min. This was followed by addition of refined vegetable oil and blended for another 1 to 2 min. This was followed by addition of spice mixture, condiments and other ingredients and again mixed for 1.5 to 2 min to get the desired emulsion. Aliquots of raw emulsions from various treatments under each trial of an experiment were collected in plastic bottles for analysis. The various ingredient used in the formulation of the chicken seekh-kababs are presented in the Table 3.

**Table 1.** Composition of spice mixture.

| Ingredient | Percent (%) |
|---|---|
| Aniseed | 12 |
| Bay leaves | 2 |
| Black pepper | 12 |
| Cardamom | 5 |
| Cinnamon | 5 |
| Cloves | 2 |
| Colored chilli | 1 |
| Coriander | 20 |
| Cumin seed | 15 |
| Mace | 2 |
| Nutmeg | 2 |
| Red chilli | 12 |
| Thymol | 10 |

**Table 2.** Composition of refined cottonseed oil (per 100 g).

| Ingredients | Percent (w/w) |
|---|---|
| Energy | 900 k. cal |
| Carbohydrate | 0 |
| Proteins | 0 g |
| Cholesterol | 0 g |
| Saturated fatty acids | 24 g |
| Mono-unsaturated fatty acids | 22 g |
| Poly-unsaturated fatty acids | 54 g |
| Trans fatty acids | 0 g |

Above values are approximate.

**Table 3.** Formulation of *kababs* from meat of spent hens.

| Ingredients | Percent (w/w) |
|---|---|
| Lean meat | 67.7 |
| Added water | 10.0 |
| Vegetable oil | 9.0 |
| Condiment mixture | 5.0 |
| Refined wheat flour | 4.0 |
| Spice mixture | 2.0 |
| Table salt | 1.5 |
| Monosodium Glutamate | 0.5 |
| Sodium Tripolyphosphate | 0.3 |
| Sodium nitrite | 120 ppm |

**Moulding of *seekh kababs***

*Kababs* were moulded on steel skewers. The steel skewers of 10 mm diameter and of length sufficient to fit in the hot air oven were used for the purpose and typically, the skewer was a round rod with one end pointed and the other blunt. Holding the skewer in one hand, an accurately weighed quantity (60 g) of meat mix/emulsion, in the form of a ball, was taken in the other hand, pierced through the pointed end and pressed on to middle of the skewer. With the help of moistened palm and fingers, it was gently spread evenly and moulded into a cigar shaped *kabab*. The length of the *kabab* was determined by the graduated scale and averaged 18 cm.

**Cooking of *seekh kababs***

Skewers with raw *kababs* on them were placed longitudinally on the two edges of a perforated oven tray in a convection oven (YORCO SALES PVT. LTD. INDIA, MODEL-YS1-431, S.NO. 02B2843). The molded raw *kababs* were smeared with vegetable oil and cooked in a preheated hot air oven at 180 ± 2°C for a total time of about 12 min. The internal temperature of *kababs* was monitored by a thermometer and cooked to an internal temperature of 78 ± 2°C. The *kababs* were removed from the skewers, cooled to room temperature and weighed. Pooled sample of each treatment was assigned for analysis.

**Analytical procedures**

The pH of raw mix/emulsion soon after its preparation and cooked *kababs* was determined by the method of Keller et al. (1974) using a digital meter (SYSTRONICS DIGITAL pH METER 803, SERIAL NO. 603). Emulsion stability of meat emulsion was determined as per procedure described by Townsend et al. (1968). Proximate composition viz. moisture, fat, ash and crude protein content of chicken *kababs*, raw and cooked were determined by standard methods described by AOAC, 1995.

**Cooking yield**

The weight of each *kabab* was recorded before and after cooking. The cooking yield was calculated and expressed as percentage by a formula:

Cooking yield percent = (Weight of cooked *kababs* x 100) / Weight of raw *kababs*

**Sensory evaluation**

The sensory evaluation of the product was carried for attributes, namely appearance, flavour, juiciness, texture and the overall acceptability of samples by a panel of trained members composed of scientists and research scholars of the 'division' based on an 8-point hedonic scale, wherein 8 denoted "extremely desirable" and 1 denoted "extremely undesirable" (Seman et al., 1987). The panels were trained for four basic tastes, that is recognition and threshold test and hedonic tests routinely performed in the 'division'. Panelists were seated in a room free of noise and odours and suitably illuminated. Coded samples for sensory evaluation were prepared and served warm to panelists. Water was provided for oral rinsing between the samples.

**Statistical analysis**

Means and standard errors were calculated for different parameters. Factorial design of experiment was fallowed. Analysis of variance was performed as per Snedecor and Cochran (1980). In significant effects, least significant differences were calculated at

**Table 4.** Effect of black bean paste extension on pH, emulsion stability and proximate composition of raw chicken *seekh-kababs*. (Mean ±SE)[*]

| Parameters | Levels of black bean extension (%) | | | |
|---|---|---|---|---|
| | 0 | 10 | 15 | 20 |
| pH | 6.09[a] ± 0.01 | 6.14[ab] ± 0.03 | 6.16[ab] ± 0.05 | 6.19[b] ± 0.01 |
| Emulsion stability (%) | 86.61[a] ± 0.29 | 91.32[b] ± 0.28 | 92.83[c] ± 0.31 | 93.41[c] ± 0.28 |
| Moisture (%) | 63.25[a] ± 0.37 | 62.63[ab] ± 0.25 | 61.92[ab] ± 0.67 | 61.36[b] ± 0.31 |
| Protein (%) | 15.62[a] ± 0.52 | 14.87[ab] ± 0.24 | 14.04[bc] ± 0.13 | 13.51[c] ± 0.50 |
| Fat (%) | 14.10[a] ± 0.10 | 13.56[ab] ± 0.21 | 13.20[bc] ± 0.29 | 12.61[c] ± 0.37 |
| Ash (%) | 2.19[a] ± 0.02 | 2.51[b] ± 0.04 | 2.79[c] ± 0.04 | 2.86[c] ± 0.03 |
| Moisture: Protein | 4.07[a] ± 0.15 | 4.22[ab] ± 0.10 | 4.40[ab] ± 0.04 | 4.58[b] ± 0.16 |

*Mean ±SE with different superscripts in a row differs significantly ($P < 0.05$), n = 6 for each treatment.

appropriate level of significance for a pair wise comparison of treatment means.

## RESULTS

The mean values of various parameters namely pH, emulsion stability and proximate composition of raw *seekh- kababs* from meat of spent hens extended with 0, 10, 15 and 20% levels of hydrated black bean (1:1 w/w) paste are presented in Table 4.

### pH and emulsion stability of raw chicken *seekh kababs*

The mean values of pH of the raw *seekh kababs* ranged from 6.09 to 6.19. An increase in pH with increase in the level of extension was recorded which was evident from significant higher value ($P < 0.05$) at 20% level (6.19) of extension as compared to control (6.09) while slightly higher values were observed at 10% (6.14) and 15% (6.16) levels which were comparable to the control and 20% levels.

The mean values of the emulsion stability ranged from 86.61 to 93.41%. A significantly higher ($P < 0.05$) value for emulsion stability was recorded at all extension levels as compared to control whereas at 15% (92.83%) extension level it was comparable to 20% (93.41%) level. The mean value of emulsion stability for control *kababs* was recorded as 86.61%.

### Proximate composition of raw chicken *seekh kababs*

The mean values of the moisture percentage of raw *seekh kababs* ranged from 61.36 to 63.25%. A gradual decrease in moisture was recorded and was significantly low ($P < 0.05$) at 20% (61.36%) level as compared to control, whereas at 10 (62.63%) and 15% (61.92%) extension levels it was comparable to others.

The mean values of the protein percentage of raw *seekh kababs* ranged from 13.51 to 15.62%. Protein percentage showed a significant decrease ($P < 0.05$) in alternate succession with highest value for control (15.62%) and lowest for *kababs* extended with 20% (13.51%) black bean paste.

The mean values of the fat percentage of raw *seekh kababs* ranged from 12.61 to 14.10%. Fat percentage also showed a significant decrease in alternate succession with highest value for control (14.10%) and lowest for *kababs* extended with 20% (12.61%) black bean paste.

The mean values of the ash percentage of raw *seekh kababs* ranged from 2.19 to 2.86%. Ash content of the *kababs* increased significantly ($P < 0.05$) with increase in levels of black bean in the formulation with highest value for *kababs* extended with 20% (2.86%) black bean paste and lowest for control (2.19%). However, at 15% (2.79%) it was comparable to 20% level.

Moisture to protein ratio showed an increase along with level of extension which was evident from significant higher value ($P < 0.05$) at 20% level of extension as compared to control while slightly higher values were observed at 10 and 15% levels which were comparable to the control and 20% levels.

### Oven roasted chicken *seekh kababs*

The mean values of various parameters namely pH, cooking yield and proximate composition of cooked *seekh kababs* from meat of spent hens extended with 0, 10, 15 and 20% levels of hydrated black bean paste (1:1 w/w) are presented in Table 5.

### pH and cooking yield of oven roasted chicken *seekh kababs*

The mean values of pH of the oven roasted *seekh kababs* ranged from 6.14 to 6.30. A significant ($P < 0.05$)

**Table 5.** Effect of black bean paste extension on physicochemical properties of oven roasted chicken *seekh-kababs*. (Mean ±SE)*.

| Parameters | Levels of black bean extension (%) | | | |
| --- | --- | --- | --- | --- |
| | 0 | 10 | 15 | 20 |
| pH | 6.14$^a$ ± 0.01 | 6.23$^{ab}$ ± 0.03 | 6.27$^b$ ± 0.02 | 6.30$^b$ ± 0.08 |
| Cooking yield (%) | 82.73$^a$ ± 0.63 | 85.69$^b$ ± 0.61 | 87.68$^c$ ± 0.52 | 88.90$^c$ ± 0.60 |
| Moisture (%) | 58.89$^a$ ± 0.76 | 58.83$^a$ ± 0.47 | 57.89$^{ab}$ ± 0.57 | 56.82$^b$ ± 0.54 |
| Protein (%) | 19.21$^a$ ± 0.55 | 18.59$^{ab}$ ± 0.62 | 17.46$^b$ ± 0.46 | 15.95$^c$ ± 0.15 |
| Fat (%) | 14.58$^a$ ± 0.46 | 14.13$^{ab}$ ± 0.50 | 13.55$^{ab}$ ± 0.40 | 12.99$^b$ ± 0.13 |
| Ash (%) | 2.31$^a$ ± 0.05 | 2.65$^b$ ± 0.06 | 2.88$^c$ ± 0.03 | 2.99$^c$ ± 0.06 |
| Moisture: Protein | 3.07$^a$ ± 0.08 | 3.19$^a$ ± 0.15 | 3.33$^{ab}$ ± 0.09 | 3.56$^b$ ± 0.05 |

*Mean ±SE with different superscripts in a row differs significantly (P < 0.05), n (Physicochemical parameters) = 6.

influence on pH and emulsion stability was recorded. The pH of cooked *kababs* at 15% (6.27) and 20% (6.30) extension levels were significantly higher (P < 0.05) than control (6.14), whereas at 10% level (6.23) pH value was comparable to all.

The mean values of cooking yield of the oven roasted chicken *seekh kababs* ranged from 82.73 to 88.90%. A significantly higher (P < 0.05) value for cooking yield was recorded at all extension levels as compared to control, however at 15% (87.68%) extension level it was comparable to 20% level (88.90%).

## Proximate composition of oven roasted chicken *seekh kababs*

The mean values of the moisture percentage of oven roasted *seekh kababs* ranged from 56.82 to 58.89%. A gradual decrease in moisture was recorded with increase in levels of lean replacement and was significantly low (P < 0.05) at 20% level (56.82%) as compared to control (58.89%), whereas at 15% (57.89%) extension level it was comparable to all others.

The mean values of the protein percentage of oven roasted *seekh kababs* ranged from 15.95 to 19.21%. Protein percentage of *kababs* showed a gradual decrease with increase in level of black bean paste and was significantly low (P < 0.05) at 15 and 20% level as compared to control, whereas at 10% (18.59%) extension level it was comparable to control (19.21%) and 15% (17.46%).

The mean values of the fat percentage of oven roasted *seekh kababs* ranged from 12.99 to 14.58%. Fat percent showed a significant decline (P < 0.05) at 20% (12.99%) extension level as compared to control (14.58%) while the other variants were comparable with both control and 20%.

The mean values of the ash percentage of oven roasted *seekh kababs* ranged from 2.31 to 2.99%. Ash percent showed a significant increase (P < 0.05) at all

extension levels as compared to control whereas at 15% level (2.88%) it was comparable to 20% level (2.99%).

Moisture to protein ratio showed an increase along with level of extension which was evident from significant higher value (P < 0.05) at 20% level of extension as compared to control. Slightly higher values were observed at 10 and 15% levels which were comparable to the control whereas at 15% level it was comparable to all.

## Sensory attributes of oven roasted chicken *seekh kababs*

The mean values of various sensory parameters of oven roasted *seekh kababs* from meat of spent hens extended with 0, 10, 15 and 20% levels of hydrated black bean paste (1:1 w/w) are presented in Table 6.

Table 6 revealed that extension with hydrated black bean paste had a significant influence (P < 0.05) on flavour, juiciness, texture and overall acceptability. The mean values of appearance scores of oven roasted *seekh kababs* from meat of spent hens ranged from 6.85 to 7.09. The appearance scores showed a declined trend with increase in percent extension level, though the decline was non-significant.

Flavour, juiciness and overall acceptability of *kababs* showed similar pattern. The scores were significantly lower (P < 0.05) at 20% extension level (6.38, 6.42 and 6.38) as compared to control (6.92, 6.92 and 7.04) and 10% level (6.71, 6.78 and 6.80); whereas these were comparable to scores at 15% level (6.59, 6.54 and 6.64). The scores at 10% extension were comparable to control while at 15% level these were comparable to 10% as well as 20% levels.

The mean values of texture scores of the oven roasted *seekh kababs* from meat of spent hens ranged from 6.33 to 6.97. The texture scores were significantly lower (P < 0.05) at 15 (6.54) and 20% (6.33) levels as compared to control (6.97) while at 10% level (6.64) it was comparable

**Table 6.** Effect of black bean paste extension on sensory attributes of oven roasted chicken *seekh-kababs*. (Mean ±SE)*.

| Sensory attributes | Levels of black bean extension (%) | | | |
|---|---|---|---|---|
| | 0 | 10 | 15 | 20 |
| Appearance | 7.09 ± 0.11 | 6.95 ± 0.07 | 6.92 ± 0.11 | 6.85 ± 0.10 |
| Flavour | 6.92[a] ± 0.09 | 6.71[ab] ± 0.10 | 6.59[bc] ± 0.09 | 6.38[c] ± 0.13 |
| Juiciness | 6.92[a] ± 0.08 | 6.78[ab] ± 0.09 | 6.54[bc] ± 0.09 | 6.42[c] ± 0.12 |
| Texture | 6.97[a] ± 0.11 | 6.64[ab] ± 0.13 | 6.54[b] ± 0.11 | 6.33[b] ± 0.16 |
| Overall acceptability | 7.04[a] ± 0.10 | 6.80[ab] ± 0.13 | 6.64[bc] ± 0.10 | 6.38[c] ± 0.14 |

[a]Mean ±SE with different superscripts in a row differs significantly (P < 0.05). Mean values are scores on 8 point descriptive scale where 1- extremely poor and 8- extremely desirable, n = 21 for each treatment.

to control and 15% level.

## DISCUSSION

### pH and emulsion stability of raw chicken *seekh kababs*

An increase in pH along with level of extension was recorded which was evident from significant (P < 0.05) higher value at 20% level of extension as compared to control while slightly higher values were observed at 10 and 15% levels which were comparable to the control and 20% levels. Gradual increase in pH with increase in extension level was expected because of neutral nature of extender and was in agreement with findings of Huang et al. (1996), Prabhakara and Janardhana (2000), Kumar and Sharma (2006) and Bhat and Pathak (2009). A significantly (P < 0.05) higher value for emulsion stability was recorded at all extension levels as compared to control whereas at 15% extension level it was comparable to 20% level. The increase in emulsion stability with increase of extension level could be attributed to gelatinizing property of increasing starch component on heating, which stabilized the emulsion (Comer, 1979). Gelatinization of this starch improves the binding properties of meat proteins (Puolanne and Ruusunen, 1983) and was in agreement with the results reported by Sharma et al. (1998), Bond et al. (2001), Kumar and Sharma (2006) and Bhat and Pathak (2009). Improvement of binding properties in meat products by addition of protein and starches of vegetable origin have also been reported by Price and Schweigert (1971); Sharma et al. (1988); Comer et al. (1986) indicated about the possible interaction between soluble meat and vegetable proteins and stated that fillers appeared to increase fat agglomeration while improving stability. It may also be attributed to high emulsifying ability of black bean paste. Shabakov et al. (1983) reported that pea flour bound both fat and water and formed stable dense foam.

### Proximate composition of raw chicken *seekh kababs*

A gradual decrease in moisture was recorded and was

significantly (P < 0.05) low at 20% level as compared to control, whereas at 10 and 15% extension levels it was comparable to others. It may be due to less moisture content in hydrated black bean paste than that of lean chicken meat. Similar findings were reported by Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009) in chicken patties and chicken *seekh kabab* respectively. Protein percentage showed a significant (P < 0.05) decrease in alternate succession. It may be due to lower protein content of hydrated black bean paste than that of chicken meat and is in agreement with the findings of Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). Fat percentage also showed a significant (P < 0.05) decrease in alternate succession. This may be attributed to the dilution effect caused by incorporation of black bean paste which is particularly low in fat content. Similar observation was reported by Kumar and Sharma (2006). Ash percent showed a significant (P < 0.05) decline at all extension levels as compared to control whereas at 15% level it was comparable to 20% level. It may be attributed to the declining trend of moisture with increasing level of extension, which results into an increasing dry matter content. Similar findings were observed by Bhat and Pathak (2009). Moisture to protein ratio showed an increase along with level of extension which was evident from significant (P < 0.05) higher value at 20% level of extension as compared to control while slightly higher values were observed at 10 and 15% levels which were comparable to the control and 20% levels.

### pH and cooking yield of oven roasted chicken *seekh kababs*

A significant (P < 0.05) influence on pH and cooking yield was recorded. The pH of cooked *kababs* at 15 and 20% extension levels were significantly (P < 0.05) higher than control, whereas at 10% level pH value was comparable to all. Gradual increase in pH with increase in extension level was expected because of neutral nature of extender and was in agreement with findings of Huang et al., (1996) and Prabhakara and Janardhana (2000), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). A

significantly (P < 0.05) higher value for cooking yield was recorded at all extension levels as compared to control whereas at 15% extension level it was comparable to 20% level. Increase in cooking yield along with increase in level of extender was as per the findings of Huang et al. (1996, 1999), Sharma et al. (1998) and Bond et al. (2001), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). But here increase was not exactly as a result of increased moisture percentage but due to higher moisture and fat retention of chicken *kababs* extended with black bean paste. This observation is in agreement with Mcwatters (1977) and Mitsyk and Mikhailovskii (1981). Grinding of black bean might have enhanced the absorptivity by increasing surface area, lowering drip losses and increasing cooking yield as suggested by Shanner and Baldwin (1979). Higher yields in comminuted meat products have also been reported by Comer (1979), Padda et al. (1989) and Minerich et al. (1991).

**Proximate composition of oven roasted chicken *seekh kababs***

A gradual decrease in moisture was recorded and was significantly (P < 0.05) low at 20% level as compared to control, whereas at 15% extension level it was comparable to others. Similar finding was observed with the incorporation of chickpea paste by Abo-Bakr (1987), Nag (1998), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). It may be due to less moisture content in black bean paste than that of lean chicken meat. Protein percentage showed a gradual decrease and was significantly (P < 0.05) low at 15 and 20% level as compared to control, whereas at 10% extension level it was comparable to control and 15%. Similar finding was observed with the incorporation of chickpea paste by Nag (1998), with barley flour and pressed rice flour by Kumar and Sharma (2005, 2006) in chicken patties and with green gram paste by Bhat and Pathak (2009) in chicken *seekh kababs*. The probable reason may be due to lower protein content of black bean paste than that of chicken meat. Fat percent showed a significant (P < 0.05) decline at 20% extension level as compared to control while others had comparable values. Similar finding was observed with the incorporation of chickpea paste by Nag (1998), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009) and may be attributed to the dilution effect caused by incorporation of black bean paste which is particularly low in fat content. Ash percent showed a significant (P < 0.05) increase at all extension levels as compared to control whereas at 15% level it was comparable to 20% level. This may be attributed to the declining trend of moisture with increasing percentage of extension, resulting to increasing dry matter content with level of extension. Jindal and Bawa (1998) also reported an increased ash content of cooked sausages with

increase in soy flour levels. Similar findings were reported by Nayak and Tanwar (2004), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). Moisture to protein ratio showed an increase along with level of extension which was evident from significant (P < 0.05) higher value at 20% level of extension as compared to control. Slightly higher values were observed at 10 and 15% levels which were comparable to the control whereas at 15% level it was comparable to all.

**Sensory attributes of oven roasted chicken *seekh kababs***

Extension with black bean paste had a significant (P < 0.05) influence on flavour, juiciness, texture and overall acceptability. The appearance scores showed a declined trend with increase in percent extension level, though the decline was non-significant. Decline in appearance could be attributed to dilution of meat pigment. Zyl and Zayas (1996), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009) reported similar results. Flavour, juiciness and overall acceptability of *kababs* showed similar pattern. The scores were significantly (P < 0.05) lower at 20% extension level as compared to control and 10% level, whereas these were comparable to scores at 15% level. The scores at 10% extension were comparable to control while at 15% level these were comparable to 10% as well as 20% levels. Flavour score deceased as a result of dilution of meaty flavour with increase in extension level. Padda et al. (1989) also observed a decline in flavour scores of goat meat balls extended with roasted Besan. Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009) also presented similar findings in the flavour of extended meat products. As the moisture retention increased with increase in extension it might have led to less preference by sensory panelists and therefore, a lower score for juiciness. Huang et al. (1999) reported similar results for juiciness in beef patties. The decrease in juiciness with increase in extension level has also been reported by Shaner and Baldwin (1979), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). The texture scores were significantly (P < 0.05) lower at 15 and 20% levels as compared to control while at 10% level it was comparable to control and 15% level. The decrease in texture scores at higher levels of extender may be due to replacement of structural meat proteins by extender as reported by Verma et al. (1984). Such a decline in texture was also supported by findings of Huang et al. (1996), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). A declining trend in overall acceptability was reflective of change in scores of flavour and texture with increased extension levels and similar findings were reported by Nag (1994), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009). The sensory of *kababs* for all attributes at 10% extension were quite comparable to control. Hence, 10% extension

with black bean paste was taken as optimum extension level for the formulation of extended chicken *seekh kababs*.

## Conclusion

The chicken *seekh kababs* from meat of spent hens can be successfully extended with black bean. Three levels viz. 10, 15 and 20% of black bean paste were used for extension of chicken *seekh kababs* and on the basis of analysis of different physicochemical and sensory parameters, 10% level of extension was adjudged as optimum for oven roasting method of cooking. Chicken *seekh kababs* of very good acceptability and nutritive value could be prepared by extension with black bean paste substituting lean chicken meat from spent hen in formulation. There is also a significant reduction in cost of the products developed without compromising with the quality which will ensure the nutritional security of the people in developing countries especially the rural one. Besides ensuring the nutritional security, it will also provide a potential outlet for the poultry industry byproduct (spent hens) and thereby increasing the profit margins of the poultry industry. Further research should be focused on the use of higher amounts and different legumes in *kababs* particularly *seekh kababs*.

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