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Efficacy of fenugreek seed powder for the development of functional spent hen meat patties

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Abstract
The diseases associated with modern lifestyle have prompted the researchers/food industry professionals to seek alternatives to conventional food products, which has subsequently led to the development of functional food products. A study was designed to enhance the overall functional value of otherwise less functional spent hen meat by using fenugreek seeds as a powder to produce functional spent hen meat patties. Fenugreek Seed Powder (FSP) was incorporated at four levels; 0.5% (T_1), 1% (T_2), 1.5% (T_3) and 2% (T_4) replacing lean meat in the formulation of the product. The results revealed an increase in the cooking yield with the increase in the levels of FSP and at 1.5% level, the cooking yield was significantly (P<0.05) higher than control. The percent protein and fat content showed a significant (P<0.05) decrease with the increase in levels of FSP. However, the percent ash of FSP incorporated spent hen meat patties was significantly (P<0.05) higher than control. The antioxidant activity in terms of DPPH-RSA value of 1.5% level was significantly higher (P<0.05) than control. Sensory scores of patties up to 1.5% level of FSP were comparable to control. Thus, it was concluded that fenugreek seed powder up to 1.5% level can be efficiently incorporated in spent hen meat patties for improving their functional value.

Keywords: Antioxidant, DPPH, FSP, functional, quality, spent hen meat patties

Introduction
The modern lifestyle adopted by majority of urban people has increased the incidence of diseases otherwise called as lifestyle diseases. Hence, alternatives in the form of functional food products which are better suited to the modern consumer are being produced in the market. Meat products considered as culprit are also redesigned to get healthier formulations. Amongst the various popular value-added meat products, patties are popular in food industry, particularly at fast food outlets [15]. Spent hen meat forms about 8.0% of total poultry meat utilized in India [5]. The meat obtained from spent hens has poor quality attributes, such as lesser juiciness and tenderness (due to high collagen content), dark colour and lowered palatability due to its low fat content and has high degree of connective tissue cross linkages also as compared to broiler meat [3,6,12]. The development of comminuted meat products offers an important alternative for the profitable disposal of spent hens. The poor quality of spent hen meat in different products can be overcome with the incorporation of suitable food additives or extenders like flours, starch and milk proteins etc. [16]. Meat of spent hen may promote faster oxidation than broiler meat during processing and storage due to higher content of unsaturated fatty acids. The meat industry is increasingly searching for natural solutions to minimize oxidative rancidity and extend the shelf-life of meat products, because the synthetic anti-oxidants have been found to exhibit various negative health effects in consumers [14]. Many natural plant extracts contain primarily phenolic compounds, which are potent antioxidants [19]. Among the medicinal plants, Fenugreek (*Trigonella foenum -graecum*) possesses many health benefits as it is immunomodulatory, anti-carcinogenic, anti-helminthic, anti-nociceptive, antioxidant, anti-microbial, anti-ulcer, gastro- and hepato-protective, anti-obesity, anti-hyperglycemic, anti-diabetic and even hypo-cholesterolemic in nature [10]. Being a potent source of functional ingredients, fenugreek seeds can be exploited for the development of different functional products. It contains amino acids like 4-hydroxyisoleucine (0.09%), histidine, arginine, lysine and small amounts of alkaloids and flavonoids. The fenugreek seeds contain other rare chemical constituents such as, coumarin, fenugreekine, nicotinic acid sapogenins, phytic acid, scopoletin and trigonelline, which are thought to account for many of its presumed therapeutic effects (inhibit cholesterol absorption and help lower sugar levels)

besides being antioxidant in nature [11]. Several workers have successfully used fenugreek and its seeds in different food products. It has been observed that fenugreek seeds improve the functional potential of different food products without affecting their consumer acceptance.

Materials and Methods

The study was conducted at the Division of Livestock Products Technology, Faculty of Veterinary Sciences and Animal Husbandry, SKUAST-Kashmir. Spent hens were procured from the local market. After proper rest and Ante-mortem examination, spent hens were slaughtered in the Experimental Slaughter Hall of the Division of Livestock Products Technology by Halal method. The dressed chicken were deboned manually and chilled overnight before use or were stored in frozen condition until used. Fenugreek seed powder was prepared by washing the fenugreek seeds thoroughly under running water and then dried at 55-60 °C for 2 hours. The dried seeds were ground to fine powder in an electric grinder and then stored in plastic containers for further use. Lean meat obtained from spent hens was minced in a mincer (MSW-627) with 4 mm plate. Meat emulsion for spent hen meat patties was prepared in Bowl Chopper (SCHARFEN, Germany). Minced meat was loaded in the bowl chopper, wherein salt along with half of chilled water was added for better extraction of salt soluble proteins. The chopping was done for 2 minutes. After that, vegetable oil was gradually added and chopping continued for another 2 minutes. This was followed by addition of whole egg liquid, dry spice mix, condiment paste (onion: garlic: ginger = 3:2:1) and other ingredients. The contents were again chopped for 1 minute to get the proper emulsion. This formulation served as control. Throughout the preparation, the Fenugreek Seed Powder (FSP) at 0.5%, 1%, 1.5% and 2% was added by replacing lean meat from the basic formulation of the product. The emulsion prepared was then weighed and molded into the shape of patties. The molded raw patties were placed on cooking trays and cooked in a preheated hot air oven at 180ºC for 30 minutes. The internal temperature of patties was monitored by a thermometer. After 15 minutes, the patties were turned upside down and returned after 5 minutes, until fully cooked. All the four treatments of spent hen meat patties viz., T_1, T_2, T_3 and T_4 having 0.5, 1, 1.5 and 2 percent FSP along with control (T_0) were assessed for various parameters *viz*., cooking yield (%), pH, moisture (%), protein (%), fat (%), ash (%), DPPH-RSA and sensory characteristics. The optimum level of FSP (1.5%) was selected on the basis of overall quality of the product. The experiment was repeated thrice.

Table 1: Basic formulation of patties

Ingredients	Percentage (w/w)
Lean meat	78.0
Ice/Chilled water	10.0
Vegetable oil	5.0
Condiment paste	3.0
Whole egg	2.0
Salt	1.0
Dry spice mix	1.0

Methods of Estimation

Cooking yield: The weight of spent hen meat patties was recorded before and after cooking and the yield was calculated as;

$$\text{Cooking yield (\%)} = \frac{\text{Cooking yield (\%) =}}{\text{Weight of uncooked emulsion}} \times 100$$

pH

The pH of spent hen meat patties was determined by the method of Trout et al. (1992) [17] by using digital pH meter (Model EE-011, Tanco Laboratory Equipments Ltd. India).

Proximate composition

The percentage moisture, protein, ether extract and ash content of the product samples were evaluated as per standard procedure of Association of Official Analytical Chemists (AOAC, 2000) [1].

DPPH assay

The DPPH assay was done according to the method of Brand-Williams [4] with some modifications. The stock solution of DPPH was prepared by dissolving 24 mg of DPPH dissolved with 100ml methanol and then stored at -20^{0}C until needed. The working solution was obtained by mixing 10ml stock solution with 80ml methanol to obtain an absorbance of 1.1±0.02 units at 515 nm using the spectrophotometer. 150µl of meat extract was allowed to react with 2850µl of the DPPH solution for 24 h in the dark. Then, the absorbance was taken at 515 nm. The radical scavenging activity was measured using the formula;

$$\text{Radical scavenging percentage (\%)} = \frac{\text{Blank absorbance Sample absorbance}}{\text{Blank absorbance}} \times 100$$

Thiobarbituric Acid Reactive Substance (TBARS) value

The estimation of TBARS value was done by following the method of Witte et al. (1970) [18] with slight modifications. 10g of sample was triturated with 25 ml of pre-cooled 20 per cent trichloroacetic acid (TCA) in 2 M orthophosphoric acid solution for 2 minutes. The content was then quantitatively transferred into a beaker by rinsing with 25 ml of chilled distilled water. After proper mixing, the contents were filtered through ash less filter paper (Whatman filter paper No. 1 supplied by GE Healthcare U.K). 3 ml of TCA extract (filtrate) was mixed with 3 ml of TBA reagent (0.005M) in test tubes and placed in a dark room for 16 hours. A blank sample was made by mixing 3 ml of 10 per cent TCA and 3 ml of 0.005 M TBA reagent. Absorbance (O.D) was measured at fixed wavelength of 532 nm using UV-VIS spectrophotometer (HITACHI, UV-Spectrophotometer U-1800). TBARS value was calculated as mg malonaldehyde per kg of sample by multiplying O.D. value with k factor 5.2.

Microbiological quality

The samples of meat products were subjected to microbiological analysis for Total Plate Count, Coliform Count and Yeast and Mould Count as per the method described by APHA [2].

Sensory evaluation

Samples of products from all treatments were presented to the semi-trained experienced taste panel members consisting of scientists and post-graduate students of Faculty of Veterinary Sciences and Animal Husbandry, Shuhama, SKUAST-K for evaluation of various sensory parameters viz., appearance, flavour, texture, juiciness, mouth coating, and overall acceptability as per 8-point descriptive scale [9], where 8 is extremely desirable and 1 is extremely undesirable. The samples were suitably warmed before serving to the panelists.

Results and Discussion

Cooking yield and pH

An increase in the cooking yield with the increase in the levels of Fenugreek Seed Powder was found and the increase was significant (P<0.05) from 1% Fenugreek Seed Powder onwards. The increase in cooking yield with FSP addition can be attributed to improvement of the hydration and binding properties of the product. The results were in agreement with Hegazy (2011) [7] who reported that the cooking yield percent of beef burger samples containing Fenugreek Seed Flour at levels of 9 and 12% was higher (P<0.05) than the control, while sample contain Fenugreek Seed Flour at level of 3% had lower cooking yield percent than control Reshi (2016) [13] found that cooking yield of spent hen meat sausages increased with the increase in incorporation of lotus stem powder. The pH values of control was significantly (P<0.05) lower than all the Fenugreek Seed Powder incorporated spent hen meat patties (FSPISHMP) and among the treatment groups, pH values increased significantly (P<0.05) with increase in levels of FSP. The slight increase in the pH values by the addition of Fenugreek Seed Powder can be attributed to somewhat higher pH (around 8) of the Fenugreek seeds as compared to the raw lean meat (around 5-6).

Table 2: Physico-chemical properties of spent hen meat patties containing various levels of Fenugreek Seed Powder (Mean±S.E)

Parameters		Fenugreek Seed Powder			
	Control	0.5%	1%	1.5%	2%
Product pH	6.31±0.01^{a}	6.32±0.01^{ab}	6.34±0.01^{bc}	6.35±0.01^{c}	6.38±0.01^{d}
Cooking yield (%)	68.41±1.02^{a}	72.26±1.88^{ab}	76.47±1.37^{bc}	78.30±1.08^{c}	80.83±1.45^{c}

Row-wise group means with different superscripts differ significantly (P<0.05)

Proximate Composition

The moisture content of all the spent hen meat patties incorporated with Fenugreek Seed Powder showed a non-significant (P>0.05) increase when compared to control Reshi (2016) [13] reported a significant (P≤0.05) increase in the moisture content of spent hen meat sausages with increasing incorporation of lotus stem powder. There was a significant (P<0.05) increase in the protein content of FSPISHMP with 1.5% and 2% levels from control. The increasing trend in the protein content of the product could be attributed to higher protein content of Fenugreek Seed Powder as compared to the lean meat (replaced in place for Fenugreek Seed Powder in the formulation of the product). The results were in agreement with Hegazy (2011) [7] who reported that the Fenugreek Seed Powder contains high protein content. Fat content of 1.5% and 2% levels showed a significant (P<0.05) increase from control. However, the fat content of control, 0.5% and 1% FSPISHMP did not differ significantly (P>0.05). The higher fat content of the Fenugreek Seed Powder could be the reason for significant increase in the fat content of Fenugreek Seed Powder incorporated meat patties. The ash content improved only slightly up to 1.5% FSP addition. The difference was significant (P≤0.05) at 2% incorporation levels only. The increasing trend of ash content with increase in the level of Fenugreek Seed Powder may be due to high levels of ash content of the Fenugreek Seed Powder as also supported by Hegazy (2011) [7].

Table 3: Proximate composition of spent hen meat patties containing various levels of Fenugreek Seed Powder (Mean ± S.E

Parameters		Fenugreek Seed Powder			
	Control	0.5%	1%	1.5%	2%
Moisture (%)	62.16±0.83	62.33±0.66	62.89±0.55	63.21±0.74	63.3±0.18
Protein (%)	19.80±0.13^{a}	20.09±0.19^{ab}	20.28±0.19^{ab}	20.49±0.23^{b}	20.57±0.14^{b}
Fat (%)	10.78±0.04^{a}	10.92±0.03^{a}	11.11±0.08^{ab}	11.37±0.14^{b}	11.42±0.20^{b}
Ash (%)	2.17±0.10^{a}	2.38±0.12^{ab}	2.46±0.10^{bc}	2.56±0.07^{bc}	2.68±0.04^{c}

Row-wise group means with different superscripts differ significantly (P<0.05)

Radical Scavenging Activity

There was an increase in the DPPH-RSA (1,1- diphenyl-2-picrylhydrazyl) values with increase in the levels of Fenugreek Seed Powder and a significant (P<0.05) increase was found at all levels from 1% FSP incorporation. The increase in the values with increasing levels of Fenugreek Seed Powder might be attributed to the better antioxidant potential of phenolic rich fenugreek seeds. Ishtiaque *et al.* (2015) [8] conducted a study on antioxidant activity and phenolic contents of ajwain, mustard, fenugreek and poppy seed and concluded that Fenugreek seeds could be utilized as a great source of antioxidants.

Table 4: Antioxidant activity of spent hen meat patties containing various levels of Fenugreek Seed Powder (Mean ± S.E)

Parameter		Fenugreek Seed Powder			
	Control	0.5%	1%	1.5%	2%
DPPH	41.88±2.79^{a}			55.74±2.70^{b}	71.22±1.20^{c}

Row-wise group means with different superscripts differ significantly (P<0.05)

Table 5: Sensory attributes of spent hen meat patties containing various levels of Fenugreek Seed Powder (Mean±S.E)

9		Fenugreek Seed Powder			
	Control	0.5%	1%	1.5%	2%
Appearance	7.90±0.07^{b}	7.43±0.16^{b}	7.38±0.19^{b}	7.14±0.19^{b}	6.95±0.19^{a}
Flavour	7.71±0.10^{a}	7.48±0.11^{a}	7.29±0.17^{ab}	7.14±0.19^{ab}	7.05±0.19^{b}
Texture	7.14 ±0.13^{b}	6.67 ±0.14^{a}	7.24 ±0.12^{b}	7.52±0.11^{b}	6.67±0.16^{a}

Juiciness	7.33±0.11^{bc}	7.00 ±0.15^{b}	7.05 ±0.16^{b}	7.67±0.11^{c}	6.52±0.20^{a}
Mouth coating	7.48±0.11^{b}	7.38 ±0.13^{b}	7.10±0.12^{ab}	7.19±0.18^{b}	6.71±0.18^{a}
Overall acceptability	7.43±0.13^{b}	7.33±0.13^{b}	7.19±0.16^{b}	7.05±0.19^{ab}	6.71±0.18^{a}

Row-wise group means with different superscript differ significantly (P<0.05)

* 8-point descriptive scale (8 = extremely desirable, 1 = extremely undesirable)

Sensory Evaluation

Most of the sensory attributes showed a declining trend with increasing FSP incorporation, but the decrease was significant (P<0.05) for all attributes including overall acceptability only at 2% FSP level of incorporation as most of the attributes of control were comparable up to 1.5% level. Hegazy (2011) [7] concluded that there was no significant difference in color, taste, flavor and appearance scores of beef burger samples with 3 and 6% Fenugreek Seed Flour (FSF) incorporation.

Conclusion

Fenugreek seeds being a rich source of various functional ingredients can be used for the development of functional meat products. Spent hen meat being relatively poor source of functional ingredients was used for the development of Functional Spent Hen Meat Patties and upon physico-chemical and sensory evaluation fenugreek seeds improved the overall value of the spent hen meat for the development of Functional Spent Hen Meat Patties.

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Author Contributions

Sheikh Rafeh Ahmad and Mohammad Ashraf Pal designed the study, Asma Irshad Qureshi performed the experiments; Asma Irshad Qureshi, Tahir Nazir, and Sheikh Rafeh Ahmad drafted the manuscript, Tahir Nazir, Mir Rovida, Asif Hassan Sofi and Henna Jalal assisted in laboratory work; Tahir Nazir analysed the data.

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