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Physico-chemical quality of spent broiler breeder hen chicken koftas added with different levels of raw banana dried powder

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ABSTRACT

The present study was undertaken to evaluate the effect of different levels of raw banana dried powder on the quality characteristics of chicken koftas. The raw banana dried powder was incorporated at three different levels viz. 2, 4 and 6% in the formulation. The products were analyzed for various physicochemical and sensory attributes. pH, emulsion stability, cooking yield, water holding capacity, moisture, crude fibre and total ash content of the products showed significant (P<0.05) increasing trend with increase in levels of incorporation of raw banana dried powder. However, a significant (P<0.05) decrease in the crude protein and ether extract content of the chicken koftas was observed with increasing levels of incorporation. Sensory evaluation revealed that koftas prepared with 4 per cent raw banana dried powder had superior scores (P<0.05) compared to 2 and 6 per cent. Hence incorporation of raw banana dried powder at 4 per cent level in chicken koftas was considered to be optimum.

Keywords: Chicken koftas, Raw banana dried powder, Physico-chemical parameters, Sensory analysis

INTRODUCTION

Poultry industry, a vibrant, organized and scientific sector now days, can play a key role in ensuring quality animal proteins at reasonable 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 rising 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 (Bhat and Pathak, 2011). 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 (Bhaskar Reddy et al. 2009). Their meat is considered poor because of higher toughness and less juiciness which are due to high collagen content and high degrees of cross linkages (Ahlawat et al. 2019) as compared to broiler meat. Problem of poor utilization can be resolved by development of further processed convenience products (Kondaiah, 1990; Bhaskar Reddy et al. 2018) such as sausages, patties, kababs, rolls, steaks, nuggets, blocks, meatballs etc.

With increasing consumer awareness, the emphasis today is shifting towards development of functional foods and incorporation of functional ingredients during processing of meat is one of the strategies for developing such foods (Jimenez-Colmenero et al. 2001). Functional meat products are generally produced by reformulation of meat by incorporating health promoting ingredients such

as fibres (Hur et al. 2009), proteins (Fernandez-Gines et al. 2005), prebiotics (Wang, 2009), probiotics (Vuyst *et al.* 2008), polyunsaturated fatty acids (Clough, 2008), antioxidants (Eim et al. 2008) etc. Fiber in meat improves functionality through their solubility, viscosity, gel forming ability, water-binding capacity, oil adsorption capacity, and mineral and organic molecule binding capacity, which affects product quality and characteristics (Tungland and Meyer, 2002). Beside these, high fiber intake tends to reduce risk of colon cancer, obesity, cardiovascular diseases, and several other disorders (Schneeman, 1999). However, due to imposition of new food laws concerning the health claims and vast regional differences in the consumption of functional foods growth opportunities remain in the global health market as scientific studies remain uncovered the benefits of both emerging and existing ingredients (Viuda-Martos et al. 2010).

Green banana flour (GBF) are rich in fibers while fiber contents are 14.0 % (Pacheco-Delahaye et al. 2008). GBF is also rich in vitamin C and A, glutathione, flavonoids and phenolics which have potent antioxidant property (Suntharalingam and Ravindran, 1993). The water absorption property of banana flours, however, depends on the degree of intermolecular bonding, while swelling power and solubility are temperature dependent, as starch molecule depolymerized by the thermal treatment (Alexander, 1995). The banana flour starts to gel formation at initial pasting temperature of 63°C (Kumar et al. 2013). Thus, raw banana dried powder is a potential ingredient for the development of fibre enriched functional meat products. Thus, the objective of this study was to examine the efficacy of raw banana dried powder on chicken meat products and also the quality and acceptability of the products were determined.

MATERIALS AND METHODS

Spent boiler breeder birds (females) of 72 weeks age were purchased from local market, transported and slaughtered at the Department of Livestock Products Technology, College of Veterinary Science, Sri Venkateswara Veterinary University, Tirupati. Slaughter and dressing was performed as per the standard procedure. After maintaining overnight in a chiller, the carcasses were hand-deboned and the meat was kept in freezer (-18±1°C) until further use. Fresh raw bananas were procured from the local market of Tirupati. The raw bananas were washed to remove adhering dirt, after draining off excess liquid vegetables were sliced, then dried in hot air oven at 60±5°C until brittle. The dried slices were grounded to fine powder and sieved.

Preparation of chicken koftas

Preliminary trials were conducted to optimize the basic formulation and processing conditions for the preparation of chicken koftas. The deboned meat was thoroughly screened for removing excess fat and tendon, etc. After adequate thawing at room temperature, meat was weighed, cut into small chunks and placed in the meat mincer. Meat mincing was done by 6 mm diameter plate and subsequently by 4 mm diameter plate (Sirman TC12E). In a minced meat, required amount of salt, polyphosphate and sucrose was added and chopped for 2 to 3 min. After addition of ice flakes, it was chopped again for 2 min. Thereafter, vegetable oil was added with continuous chopping followed by incorporation of condiment, raw banana dried powder, refined corn flour and spice mix. Chopping ended after formation of uniform batter mix. After preparing emulsions, small koftas weighing approximately 20 g were prepared and were deep fat fried till the desired brown color and an internal temperature of 72°C was attained. The product was evaluated for its quality on the basis of physico-chemical characteristics viz. pH, cooking yield, emulsion stability, water holding capacity, proximate composition (moisture, fat, fibre, protein and ash) and sensory evaluation and the best level was selected. Experiment was replicated thrice. Formulations of control and different treatments were presented in Table 1.

Table 1: Formulations of spent broiler breeder hen chicken koftas added with raw banana dried powder.

Ingredients	Control	Spent broiler breeder hen chicken koftas incorporated with raw banana dried powder		
		T1	T2	T3
Spent broiler breeder hen chicken meat	68.7	66.7	64.7	62.7
Vegetable fat	10	10	10	10
Raw banana dried powder	-	2	4	6
Salt	2	2	2	2
Sugar	1	1	1	1

Poly phosphate	0.3	0.3	0.3	0.3
Dry spice mix powder	2	2	2	2
Wet condiment mix*	3	3	3	3
Binder (corn flour)	3	3	3	3
Ice flakes	10	10	10	10
Total	100	100	100	100

*Onion: garlic paste (3:1); T1-2% raw banana dried powder, T2-4% raw banana dried powder, T3 -6% raw banana dried powder

Proximate analysis

The moisture, protein, fat, fiber and ash contents of chicken koftas were determined by protocols described in AOAC (2002).

pH

The pH of chicken koftas was measured by using digital pH meter as suggested by Trout et al. (1992) for which suspension was made by blending 10 g of sample with 50 ml distilled water. The pH of suspension was measured with the help of digital pH meter equipped with a combined glass electrode.

Emulsion stability

Emulsion stability of meat emulsion was determined as per the procedure of Townsend et al. (1968). Polyethylene bags (12 x 10 cm) containing 25 g samples were sealed, and immersed in thermostatically controlled water bath at 80°C for 20 min. The bags were removed from the water bath, cut open and cooked fluids (fat, water and solids) were drained out and weighed. The weight of product after cooking was measured and expressed in percentage emulsion stability.

Water-holding capacity (WHC)

Water holding capacity was determined according to Wardlaw et al. (1973). 20 g of finely chopped meat sample was placed in a centrifuge tube containing 30 ml NaCl (0.6 M) and was stirred with glass rod for 1 minute. The tube was then kept at refrigeration temperature (4±1°C) for 15 min, stirred again and centrifuged at 3000 rpm using refrigerated centrifuge (REMI R-8C, Serial no: JGLC-12753, Remi Elektrotechnik Limited, Vasai, India) for 15 min. The supernatant was measured and amount of water retained by samples were expressed as WHC in percentage.

Cooking yield

The weight of each meatball was recorded before and after frying. The yield was calculated and expressed as percentage (Murphy et al. 1975).

$$\text{Cooking Yield}(\%) = \frac{\text{Weight of cooked product}}{\text{Weight of raw product}} \times 100$$

Sensory evaluation

Sensory evaluation

The quality of chicken koftas for various sensory attributes viz., appearance, flavour, juiciness, texture and overall acceptability was evaluated by five semi trained academic staff members as a sensory panel member by using 8 point descriptive scale (Keeton, 1983). Before evaluation, the panelists were told the nature of experiment without giving any identity.

Statistical Analysis

The data obtained during the experiment were analyzed as per following the procedure described by Snedecor and Cochran (1995).

RESULTS AND DISCUSSION

The processing parameters to obtain acceptable quality chicken koftas using different levels of raw banana dried powder were optimized. The results pertaining to physico-chemical properties presented in Table 2, proximate composition were presented in Table 3 and sensory evaluation of koftas were presented in Table 4.

Physico-chemical properties

The mean pH values of raw banana dried powder incorporated spent broiler breeder hen chicken koftas were decreased gradually with increase in levels of raw banana

dried powder but the difference was not significant (P>0.05) between treatments. This might be attributed due to depolymerisation of starch granules of green banana flour caused by the thermal treatment during cooking (Bhaskar Reddy et al. 2022). Hence producing acid terminal residues in the starch molecules (Perez, 1997). Similar results were reported by Pereira et al. (2020) in fat-reduced frankfurters, Chappalwar *et al*. (2021) in chicken patties and Diego et al. (2021) in fiber enriched frankfurter-type sausages. The cooking yield, emulsion stability and water holding capacity of the products followed an increasing trend with increasing levels of raw banana dried powder in the formulation and noticed significantly(P<0.05) higher values for T3 koftas than others. This might be attributed due to presence of pectin in cooking banana that constitutes up to 66% of the fiber concentrate (Pacheco-Delahaye et al. 2008) which promotes water retention capacity thereby improves the emulsion stability (Choi et al. 2009 and Bhaskar Reddy et al. 2017). Similar results reported by Kumar et al. (2013) in chicken nuggets, Madane et al. (2019) in chicken nuggets, Sharma and Yadav (2020) in chicken patties and Mohd Zaini et al. (2021) in chicken sausages.

Proximate composition

A significant (P< 0.05) increase in moisture and crude fibre percent was recorded with increase in each level of raw banana dried powder. The moisture and crude fibre content was highest at 6 percent level and it differed significantly (P< 0.05) with all other levels of incorporation. This might be due to the addition of green banana flour having dietary fiber on an average of 11.6% neutral detergent fibres and 3.1% acid detergent fibres which increases water retention capacity (Pacheco-Delahaye et al. 2008 and Choi et al. 2010). These results are correlated with Choi *et al*. (2012) in chicken frankfurters and Sharma and Yadav (2020) in chicken patties. A gradual decrease in crude protein and crude fat was recorded and was significantly (P < 0.05) higher at 2 percent level as compared to other levels of raw banana dried powder. This is could be due to inversely proportional of moisture and protein content in products and fibre addition (Choi et al. 2009 and Kumar et al. 2013). Similar results were reported by Choi et al. (2012) in chicken frankfurter and Rindhe et al. (2018) in functional spent hen nuggets. A significantly (P < 0.05) higher value for total ash was observed at all incorporation levels as compared to control and T3 koftas recorded significantly(P<0.05) higher values than other treatments. This might be due to higher ash content of bananas as those are rich in minerals such as sodium, potassium, iron, calcium and

Table 2: Effect of incorporation of different levels of raw banana dried powder on the physico-chemical properties of spent broiler breeder hen chicken koftas (Mean ± S.E)

Parameters	Control	Spent broiler breeder hen chicken koftas incorporated with raw banana dried powder		
		T1	T2	T3
pH	6.00^{b}±0.006	5.95^{a}±0.004	5.94^{a}±0.011	5.93^{a}±0.006
Cooking yield (%)	87.57^{a}±0.010	92.46^{b}±0.012	93.62^{c}±0.008	94.32^{d}±0.004
Emulsion stability (%)	87.76^{a}±0.012	93.46^{b}±0.008	94.23^{c}±0.009	94.74^{d}±0.011
Water holding capacity (%)	49.64^{a}±0.011	52.34^{b}±0.008	54.58^{c}±0.006	55.27^{d}±0.009

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.
T1-2% raw banana dried powder, T2-4% raw banana dried powder, T3 -6% raw banana dried powder

Table 3. Effect of incorporation of different levels of raw banana dried powder on the proximate composition of spent broiler breeder hen chicken koftas (Mean ±S.E).

Proximate composition (%)	Control	Spent broiler breeder hen chicken koftas incorporated with raw banana dried powder		
		T1	T2	T3
Moisture	64.65^{a}±0.047	65.69^{b}±0.082	66.12^{c}±0.015	66.77^{d}±0.009
Crude protein	20.86^{d}±0.043	20.03^{c}±0.017	19.41^{b}±0.008	19.02^{a}±0.013
Crude fibre	0.64^{a}±0.013	2.23^{b}±0.017	2.58^{c}±0.009	2.81^{d}±0.011
Crude fat	11.01^{d}±0.022	9.62^{c}±0.006	8.96^{b}±0.012	8.43^{a}±0.010
Total ash	2.23^{a}±0.032	2.70^{b}±0.006	3.14^{c}±0.010	3.58^{d}±0.004

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.
T1-2% raw banana dried powder, T2-4% raw banana dried powder, T3 -6% raw banana dried powder

Table 4: Effect of incorporation of different levels of raw banana dried powder on the sensory scores of spent broiler breeder hen chicken koftas (Mean ± S.E).

Sensory scores	Control	Spent broiler breeder hen chicken koftas incorporated with raw banana dried powder		
		T1	T2	T3
Appearance	7.14^{c}±0.008	7.15^{b}±0.008	7.22^{c}±0.028	7.04^{a}±0.011
Flavour	6.83^{c}±0.011	6.86^{b}±0.008	7.06^{c}±0.010	6.23^{a}±0.014
Juiciness	7.00^{b}±0.004	6.98^{b}±0.009	6.99^{b}±0.011	6.40^{a}±0.008
Texture	7.00^{b}±0.024	6.98^{b}±0.016	7.05^{c}±0.010	6.14^{a}±0.010
Overall acceptability	7.07^{b}±0.030	7.08^{b}±0.031	7.21^{c}±0.028	6.65^{a}±0.008

(P<0.05); Means bearing at least one common superscript in the same row do not differ significantly.
T1-2% raw banana dried powder, T2-4% raw banana dried powder, T3 -6% raw banana dried powder.

even phosphorus (Vernaza et al. 2011 and Kumar et al. 2013). Similar increase reported by Bhaskar Reddy et al. (2017) in chevon sausages extended with foxtail millet flour and Sharma and Yadav (2020) in chicken patties.

Sensory analysis

The mean values of various sensory parameters namely appearance, flavour, juiciness, texture and overall acceptability of chicken koftas incorporated with 2, 4 and 6 percent levels of raw banana dried powder are presented in Table 4. The mean appearance and flavour scores of spent broiler breeder hen chicken koftas were significantly (P<0.05) affected by formulation. T2 koftas recorded significantly (P<0.05) higher scores compared to the other treatments. This might be attributed due to the masking effect of darker colour of dried powder at lower levels and comparatively mild perception of desirable meaty flavour in the products at higher level of incorporation (Gonzalez and Enriquez, 1994, Brijesh *et al*. 2013 and Bhaskar Reddy et al. 2018). Decline in appearance scores could be attributed to dilution of meat pigments. Reduction in the flavour with the increasing level GBF might be due to dilution of meaty flavour in the products as reported by Kumar and Sharma (2004). Similar trend was also recorded by Kumar et al. (2013) in chicken nuggets and Ahlawat et al. (2019) in spent hen chicken nuggets. The mean juiciness and texture scores of spent broiler breeder hen chicken koftas were affected significantly (P<0.05) by addition of raw banana dried powder and T2 koftas scored significantly (P<0.05) higher values and T3 koftas scored significantly (P<0.05) lower scores than other treatments. This might be due to the fact that T2 have bounded more water compared to other treatments and decline in texture scores due to replacement of structural meat proteins by extender at higher levels of incorporation (Bhaskar Reddy et al. 2022). The decline in juiciness and texture scores might be due the fact that dietary fibre may disturb the protein-protein or protein-water gel network (Kyung et al. 2018). Similar results were reported by Bhaskar Reddy et al. (2009) in chicken nuggets and Ahlawat et al. (2019) in spent hen chicken nuggets. The mean overall acceptability scores of spent broiler breeder hen chicken koftas were affected significantly (P<0.05) by addition of raw banana dried powder and T2 koftas recorded significantly (P<0.05) higher mean overall acceptability scores followed by T1, T3 and control. This might be due to the fact that T2 koftas recorded significantly (P<0.05) higher scores for colour, flavour, and texture that might have influenced the panelists to rate high for overall acceptability also (Bhaskar Reddy et al. 2022).

CONCLUSION

The present study showed successful utilization of raw banana dried powder for the development of spent broiler breeder hen chicken koftas. Based on the results, it can be concluded that 4% level of raw banana dried powder incorporated spent broiler breeder hen chicken koftas had better acceptability and enhanced functionality in terms of dietary fiber.

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