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ORIGINAL ARTICLE

Effect of Indian *Jujube* pulp on physico-chemical and sensory characteristics of chicken sausages

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Abstract

A study was undertaken to evaluate the effect of Indian jujube pulp on the quality attributes of chicken sausages incorporated at 0%, 5%, 10% and 15% level (replacing lean meat) into the formulation of chicken sausages. The proximate, physico-chemical and sensory properties of sausages were analyzed. Among the different proximate and physico-chemical parameters, a significant ($p<0.05$) decrease in pH, emulsion stability, ash content, cooking yield, ether extract as well as crude protein percentage with each subsequent incorporation level was accompanied by a gradual increase in moisture of cooked sausages. However, crude fiber content increased significantly ($p<0.05$) with increasing level of inclusion. The sausages with 10% level of Indian jujube pulp incorporation had highest ($p<0.05$) overall acceptability score.

Keywords: Indian jujube pulp, chicken sausages, proximate analysis, sensory attributes.

Introduction

Increasing consumer demand for the quality meat products results in the development of meat products by incorporating health enhancing ingredients. The non-meat ingredients are used in meat products to improve the quality and reduce the cost of the products (Yadav *et al.*, 2013). These ingredients of very wide sources such as dairy, eggs, plants and microbial including probiotics are incorporated in these meat products (Abdolghafour and Saghir, 2014). Sausages are one of the popular ready to eat meat products available worldwide. Typically, the sausage is formed in a casing traditionally made from intestine of the farm animals and synthetic, producing the characteristic cylindrical shape utilizing ground meat and often salt, herbs and spices. The word sausage is derived from the Latin word *salsus*, meaning salted. Sausage making is a traditional food preservation technique by using curing, drying, or smoking techniques. Some sausages are cooked during processing and the casing may be removed afterwards. The changes in consumer's life style and rapid expansion of the fast food market including meat and meat products (McDonald, 2009). People have become more health conscious and try to reduce dietary calorie intake by adding dietary fibre in the formulation so meat products are generally produced by incorporating ingredients like green vegetable fibres, fruits, protein, polyunsaturated fatty acids, antioxidants, vitamins and minerals etc (Egbert *et al.*, 1991; Kumar *et al.*, 2013; Mendiratta *et al.*, 2013). Incorporation of fruits endorses the healthy image of meat products (Mansour and Khalil, 1997). In contrast to the study dealing with the health influences of the addition of fruit and vegetables, there is a very limited research about the technological, physicochemical, organoleptic, and microbiological properties of fruit-added meats.

Fruits as fibers have been found successful in improving functional value, cooking yield, reducing formulation cost and enhancing texture (Keeton, 1994; Akoh, 1998). Fibre has many health benefits besides improving technological properties of the products (Mansour and Khalil, 1997). Indian jujube (*Ziziphus mauritiana* Lamk.) is also known as ber, desert apple or Indian plum. It belongs to family *Rhamnaceae*. It is a tropical/subtropical fruit native to the northern hemisphere (Lyrene, 1979). Ber fruit have a high nutritive value, being a rich source of vitamin C, A, and B complex, and also of Ca, K, Br, Rb, and La (Tiwari and Banafar, 1995). In general, the fruit contain 81-83% moisture**,** 17.0% carbohydrates, 0.8% protein, 0.07% fats, 0.76-1.8% iron, 0.03% each of calcium and phosphorus, 0.02 mg/100g carotene and thiamine, 0.020-0.038 mg/100g riboflavin, 0.7-0.9 mg/100g niacin, 0.2-1.1 mg/100g citric acid, 65-76

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mg/100g ascorbic acid, about 22 g/100g sugar, about 1.3 g/100g fiber, about 0.2 g/100g fat with a calorific value of 104/100g (Morton, 1987). Keeping the above view, the present study was planned to assess the effect of Indian Jujube pulp on physico-chemical and sensory quality of chicken sausages.

Materials and Methods

The deboned chicken meat was procured from local market and then the meat was packed in polythene bags and kept at -18^{o}C till utilized. All the chemicals to be used were of analytical grade and were obtained from standard firms. After removal of extraneous matter all spices were dried in an oven at 60^{0}C for overnight and then ground in grinder to powder. The coarse particles were removed using a sieve and the fine powdered spice were mixed in required proportion to obtain spice mixture for chicken nuggets and was stored in plastic airtight container for subsequent use. To prepare condiments onion, garlic and ginger (3:2:1) were procured from local market and then these were peeled off and cut in small pieces and homogenized to obtain a fine paste. The fruit fiber viz. Indian jujube (Ber) was obtained from local market. It was peeled properly, cut into smaller pieces and grounded in a mixer to make paste. The paste of the Indian jujube was utilized as a source of fiber. Now it was incorporated at 0%, 5%, 10% and 15% levels in the formulation replacing lean meat. Refined cotton seed oil of brand name 'Shreeji' was purchased from local market and used. Low-density polyethylene film pouches in natural colour were used for packaging.

Physic-chemical analysis

The proximate composition (moisture, fat, protein, fibre and ash) were estimated as per the procedure as outlined by AOAC (1995). The pH of chicken sausages was measured soon after its preparation by the method of Keller *et al.* (1974). The emulsion stability of meat emulsion was estimated as per procedure described by Townsend *et al.* (1968). The cooking yield of chicken sausages was recorded before and after cooking. The cooking yield was calculated and expressed as percentage by a formula: Cooking yield percent=Wc/Wr×100 (where Wc = weight of cooked product and Wr = weight of raw emulsion).

Sensory analysis

The 8 point hedonic scale was employed for sensory evaluation of chicken sausages (Keeton, 1983) by semi-trained panelists, where 1 = extremely disliked and 8 = extremely liked for colour and appearance, flavour, texture, juiciness and overall acceptability.

Statistical analysis

Finally the results were analyzed statistically for analysis of variance and least significant difference tests using the software of Statistical Package for Social Sciences (SPSS 16.0). The statistically analyzed results were tabulated and interpreted.

Results and Discussion

Physico-chemical qualities of chicken sausages

The details of physic-chemical qualities of sausages were presented in Table 1. The pH was significantly ($p<0.05$) lower at 15% level of incorporation as compared to other two levels of incorporation as well as control. A significant ($p<0.05$) decreasing trend in cooking yield was reported in the products with the increasing level of incorporation of Indian jujube pulp. Emulsion stability decreased significantly ($p<0.05$) with the increasing levels of incorporation of the Indian jujube pulp. At 15% level it was significantly ($p<0.05$) lower as compared to control. A gradual significant ($p<0.05$) increase in moisture percent was recorded with increase in the level of incorporation and was significantly higher at 15 percent level as compared to control. The crude protein content decreased gradually with increase in the level of Indian jujube pulp and it was significantly ($P<0.05$) lower at 15 percent level as compared to control. A gradual decrease in ether extract content was recorded and was significantly ($P<0.05$) low at 10% and 15% level as compared to control, although the former two were comparable with other. Ash content of the products decreased significantly ($P<0.05$) with the pulp incorporation and was significantly ($P<0.05$) lower in the chicken sausages prepared with the incorporation of 15% Indian jujube pulp. An increasing trend in crude fiber level was observed with increasing levels of incorporation.

There was a gradual decrease in pH with increase in the level of Indian jujube pulp. This might be possibly due to low pH of Indian jujube pulp used in the formulation. Decrease in the emulsion stability with increase in the levels of Indian jujube pulp may also act as a contributing factor for decreasing the cooking yield. The decrease in emulsion stability might be due to linear decrease in pH as well as interaction of water molecules of Indian jujube pulp with meat proteins thereby reducing the emulsion stability. This study is in agreement with Bhosale *et al.* (2011) who reported similar findings in chicken nuggets incorporated with ground carrot and mashed sweet potato at different levels (0, 5, 10, 15%). The moisture content of cooked chicken sausages increased significantly ($p>0.05$) with every increase in the level of pulp.

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Table 1: Effect of Indian jujube pulp on ph, cooking yield and proximate composition of cooked chicken *sausages.* (Mean± se)*

Parameters	Levels of Pulp (%)			
	0	5	10	15
pH	6.43^{d} ±0.02	6.27^{c} ±0.01	6.11^{b} ±0.01	6.00^{a} ±0.01
Cooking Yield (%)	90.11^{d} ±0.10	91.10^{c} ±0.16	88.09^{b} ±0.10	87.53^{a} ±0.11
Emulsion Stability (%)	91.06^{d} ±0.16	90.17^{c} ±0.10	89.09^{b} ±0.07	88.12^{a} ±0.11
Moisture (%)	61.10^{a} ±0.20	62.20^{b} ±0.11	63.03^{c} ±0.16	64.16^{d} ±0.18
Crude Protein %)	16.01^{c} ±0.25	16.20^{c} ±0.15	15.01^{b} ±0.25	14.16^{a} ±0.27
Ether extract (%)	13.54^{c} ±0.11	13.41^{b} ±0.21	12.50^{a} ±0.16	12.21^{a} ±0.10
Ash (%)	2.37^{d} ±0.16	2.07^{c} ±0.11	1.97^{b} ±0.12	1.36^{a} ±0.11
Crude Fiber (%)	0.52^{a} ±0.06	0.74^{a} ±0.06	1.11^{b} ±0.09	1.52^{c} ±0.04

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

Table 2: Effect of Indian jujube pulp on sensory attributes of cooked chicken *sausages.* (Mean± se)*

Sensory Attributes	Levels of Indian Jujube Pulp (%)			
	0	5	10	15
Appearance &colour	7.10^{a}±0.05	7.36^{a}±0.12	7.38^{a}±0.11	7.81^{b}±0.16
Flavour	6.41^{a}±0.12	6.42^{a}±0.11	7.54^{b}±0.16	7.59^{b}±0.14
Juiciness	5.01^{a}±0.15	5.12^{a}±0.12	6.89^{b}±0.13	7.59^{c}±0.18
Texture	7.44^{b}±0.05	7.40^{b}±0.16	7.10^{b}±0.12	6.15^{a}±0.13
Overall acceptability	6.57^{ab}±0.21	6.88^{b}±0.19	7.87^{c}±0.11	6.49^{a}±0.14

**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.*

This might be due to higher moisture content of the indian jujube pulp. Similar results were observed by Fernandes-Gines *et al.* (2004) in cooked lemon albedo fibres (2.5-5%) in bolognas which showed higher moisture content than control. This decrease in the crude protein content is in conjunction with Candogan (2002) who observed similar trends in beef patties with added tomato paste.

The decrease in the ether extract content is in agreement with the results of Valeria *et al.* (2008) who prepared dry fermented sausages by the incorporation of carrot dietary fibers and Aleson-Carbonell *et al.* (2004) who prepared non-fermented dry-cured sausages formulated with lemon albedo. The decrease in the ash content might be due to low ash content of Indian jujube pulp used in the formulation. Kassem and Emara (2010) reported an increase in moisture, and decrease in fat, protein and ash in cooked control and vegetable (pea and carrot) treated beef burger patties. The crude fiber content was significantly ($p<0.05$) higher in the products with 15% added pulp in the formulation as compared to control. This was found in agreement with Verma *et al.* (2010) who observed a significant ($p<0.05$) increase in dietary fiber content in chicken nuggets by sodium chloride replacement and apple pulp inclusion. Mendiratta *et al.* (2013) reported that addition of vegetables have no significant effect on pH, moisture, fat and cooking yield, however significant difference was observed in protein content.

Sensory attributes of cooked chicken sausages

The details of sensory qualities of sausages were presented in Table 2. The appearance and colour of *sausages* improved gradually with the increasing level of pulp incorporation. The flavour scores were significantly ($p<0.05$) higher with pulp incorporation although comparable at 10 and 15 percent level of incorporation than control. Juiciness score were significantly ($p<0.05$) higher at 15% level as compared to control. The *sausages* were extremely juicy at 15% level of incorporation. The texture score followed a linear decreasing trend in the present study. The overall acceptability score of the products was highest at 10% level of incorporation.

The appearance scores were significantly ($p<0.05$) higher at 15% level of incorporation than control. The appearance and colour scores increased with more carrot and onion added in Chinese style *sausages* (Chang et al., 2010). Increase in the flavour score could be possibly due to the typical flavor of the raw pulp used in the formulation. Increase in juiciness might be due to increase in moisture content in the treated products due to pulp incorporation. The products with 15% added pulp in the formulation had significantly ($p<0.05$) lower texture score as compared

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to control. This could be attributed to higher moisture retention property by the products at increased levels of incorporation. The overall acceptability score was least at 15% level of incorporation and highest at 10% level of incorporation. This study is in conjunction with Dasiewicz and Urcus (2009) who reported that fiber incorporation did not negatively influence the sensory properties of products. Mendiratta *et al*. (2013) reported that sensory score were significantly higher in vegetable incorporated meat nuggets. They further reported that vegetable incorporated mutton nuggets were successfully improved the functional and sensory quality.

Conclusion

The chicken Sausages can be successfully prepared with the incorporation of Indian jujube pulp and on the basis of different physico-chemical and sensory parameters, incorporation of 10% pulp was found to be optimum for the preparation of functional sausages. Emphasis should be given on utilization of locally available vegetables and fruits in the meat products.

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