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Development of chicken patties incorporated with different extenders of plant origin

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Abstract
Different levels of carrot paste (14, 18 and 22%) and radish paste (14, 18 and 22%) were incorporated in chicken patties formulations. Emulsion prepared from minced and blended broiler meat, with the inclusion of spices, condiments and extenders was used for the preparation of chicken patties. It was observed that 14% carrot paste was found to be optimum for incorporation in chicken patties. Results revealed that chicken patties containing 14% carrot paste exhibited optimum score whereas emulsion stability and cooking yield were comparable to control. Similarly, chicken patties containing a 14% level of radish paste exhibited higher sensory and physico-chemical scores which were comparable to control.

Keywords: Chicken patties, plant origin, emulsion

Introduction
The poultry industry being an important wing of the Indian economy has been recognized as a potential tool to fight poverty and malnutrition with tremendous employment opportunities. Poultry meat is more acceptable because of its flavour, ease of digestion, low-fat content and high ratio of unsaturated fatty acids and thus can play a significant role in the development of value-added innovative processed poultry products. Poultry meat is more popular than other meat not only due to the higher rate of returns to the producers but also because it is an excellent source of animal protein, has no religious taboo and is acceptable to all non-vegetarian populations. A wide variety of non-meat products are being utilized as extenders, binders or fillers in comminuted meat products. These include soy flour, soy protein concentrate, soy isolate, textured soy proteins, non-fat dry milk, skim milk co-precipitates, yeast extract, dried extract etc. They are added to meat formulations for one or more reasons *viz*., to improve the emulsifying capacity, emulsion stability, water binding potential, nutritive value and slicing characteristics etc. They also improve the cooking yield, palatability and texture of the finished products. In recent years, some fruits and vegetables have gained the importance of functional foods, as they are a rich source of natural antioxidants, dietary fibres, essential minerals and vitamins. So far, very limited research work has been conducted on the suitability and antioxidant potential of vegetables like carrots and radish in comminuted meat products. It has revitalized the interests not only of consumers but also among researchers and meat food product processors to develop formulated products, which are "natural", "functional" and "nutritional" as well. Many efforts have been made to develop functional-based value-added meat products but in most of cases, they are less palatable to consumers (Choi and Chin, 2003) [9]. Carrot is one of the richest sources of β-carotene, iron, pectins, dietary fibres, complex carbohydrates, and various minerals. Similarly, sweet potatoes are rich in complex carbohydrates, dietary fibres, β-carotene, vitamin C and vitamin B_6. The antioxidant activity of dried radish chip extract (DRCE) in pork sausage had been reported by Sugita *et al.* (1993) [1]. Therefore, an extension of meat and meat products with green vegetables could improve nutritional quality (dietary fibres, essential minerals and vitamins) and thus provide an opportunity to formulate healthier meat products. Further, the suitability of incorporation of vegetables to produce healthier meat products relates to their properties such

as water binding capacity, fat emulsification and sensory attributes.

Materials and Methods

Broilers of around 6 weeks of age were dressed at a local meat shop in Parbhani city following the traditional halal method. The body fat, tendons and separable connective tissues were trimmed off. The dressed meat was packed in polyethylene pouches and frozen at –18±1°C overnight which were then subsequently used for product formulation. Spice ingredients *viz*., aniseed (*Soanf*), black pepper (*Kali mirch*), capsicum (*Lal mirch*), caraway seed (*Ajowan*), cardamom (*Badi elaichi*), cinnamon (*Dalchini*), cloves (*Laung*), coriander powder (*Dhania*), cumin seeds (*Zeera*), dried ginger (*Sunth*) and turmeric (*Haldi*) procured from the local market were cleaned to remove the extraneous matter thereafter dried in hot air oven at 60°C for $2^1/_2$ hrs. Ground in a grinder using a suitable blade and finally sieved through a fine mesh. The powdered mixture having the required proportion of each ingredient (Sakunde, 2004 with slight modification) [5] was used subsequently as a spice mix for the preparation of chicken patties. All the chemicals of analytical grade were procured from standard firm *viz*., Himedia, Qualigens and Loba Chemie along with food-grade commercial salt (NaCl). The vegetables used in the study as extender *viz*., carrot and radish were procured from local market of parbhani city. Carrots were washed with tap water for cleaning purpose and removal of extraneous dirt. The clean carrots were peeled manually with knife, cut into slices and ground to paste in mixer. Similar procedure was followed to prepare radish paste and used subsequently as an extender in chicken patties formulation. Condiments *viz*., onion and garlic after removing external coverings were cut into small pieces and fine paste was prepared in a blender using 4:1 ratio. Maida (Refined wheat flour), food grade common salt and refined vegetable sunflower oil required for preparation of chicken patties was procured from the local market. Broiler meat after deboning was kept at freezing temperature (-18±1°C) overnight. After adequate thawing, it was cut into small chunks and minced in blender. Minced meat was blended for desired duration. The chicken patties were prepared from emulsion. Fried chicken patties were subjected to sensory evaluation and physico-chemical analysis.

Incorporation of Carrot

Sensory Quality

The mean scores for sensory attributes of chicken patties incorporated with different levels of carrot (14, 18 and 22%) are presented in Table 1. It is observed from the table that the sensory scores for all the quality attributes of chicken patties differed significantly ($p<0.05$) due to the incorporation of different levels of carrot. It is revealed from observations that the incorporation of carrots up to 18% level did not have any significant effect ($p>0.05$) on the appearance scores of products. Carrot incorporated with 14% recorded optimum sensory scores for appearances as compared to that of control. It might be due to the addition of carrot as it contains colour pigments carotenoid which impart colour to the product (Bhosale, 2009) [11]. While carrots incorporated at a 22% level had significantly lower appearance scores as compared to control and other treatments. According to Alamanou *et al.* (1996) [13], aroma and flavour are the most important attributes that influence the sensory properties of comminuted meat products. The addition of carrots up to 14% did not change flavour intensity while 18% had a significantly lower ($p<0.05$) flavour score which might be attributed to raw carrots. But the taste of the product was improved as sugar residues from the carrots, amino acids and small peptides from the meat form a maillard reaction product upon heating which gives a palatable taste to the meat product a palatable taste. Present findings are in agreement with Devatkal *et al.* (2004) [8] who reported a significant decrease in the flavour score of liver-vegetable buffalo loaf extended with carrot paste. The sensory scores of juiciness for 14% carrot extended chicken patties did not differ significantly ($p>0.05$) as compared to the control. As the carrot level increases the scores for juiciness decrease significantly ($p<0.05$). It might be due to higher fibre content and decreased fat content of the products. The findings of the present investigation are in agreement with those of Berry and Leddy (1989) [12] for beef patties and Kregel *et al.* (1986) [6] for ground beef. The texture of the carrot-treated products differed significantly ($p<0.05$) as compared to control. However, no significant difference ($p>0.05$) was observed between the control and 14% carrot-extended chicken patties. It might be due to the property of added fibre which has unique characteristics in building texture, because of its ability to bind water and form gels. However excess addition of carrot subsided this effect. Similar findings were recorded by Bhosale (2009) [11] for chicken nuggets. In contrast, Saleh and Ahmed (1998) [4] reported significantly higher scores for the texture of cooked beef patties added with boiled carrots. A similar declining trend was observed for the overall palatability of carrot-extended chicken patties. Among the treatments, 14% of carrot extended chicken patties recorded significantly ($p<0.05$) higher scores for overall palatability which could be attributed to higher scores for other sensory attributes *viz*., appearance, flavour, juiciness and texture. However, the overall palatability score of extended chicken patties did not differ significantly from the control. Present findings are in agreement with Shinde (2005) [3].

Physico-Chemical Properties

The data about physico-chemical characteristics of chicken patties as influenced by the incorporation of different levels of carrot are presented in Table 2. It indicates that the addition of raw carrots in chicken patties slightly decreases pH. Significantly ($p<0.05$) lower pH was recorded for 22% carrot extended chicken patties. It might be due to the lower iso-electric pH of carrot paste. A similar trend was recorded for emulsion stability as that of pH. But control group had significantly ($p<0.05$) higher emulsion stability than 22% carrot extended chicken patties. There was a slight decrease in emulsion stability with increasing levels of carrot paste. Among the treatments highest emulsion stability was recorded for 14% carrot-extended chicken patties. This was attributed to more denaturation of muscle fibre protein which takes place at lower pH. These findings are in agreement with those of Devatkal *et al.* (2004) [8] reported a decrease in the emulsion stability of buffalo liver loaf extended with carrot paste. A gradual decline in cooking yield was noticed in upto 14% carrot extended chicken patties as compared to control. The subsequent addition of carrots resulted in a significant ($p<0.05$) decrease in the cooking yield of chicken patties. This result is broadly in agreement with the observations of Saleh and Ahmed (1998) [4]. They reported a decrease in cooking yield due to the addition of mashed carrots in ground beef patties. An increasing trend was recorded for moisture content due to the addition of an increased level of carrot. Chicken patties prepared with the incorporation of 22% carrot showed

significantly (p<0.05) higher moisture content than the control but they were non significantly (p>0.05) variable when compared to 14 and 18%. Similar findings were reported by Devatkal *et al.* (2004) [8]. They reported an increase in the moisture content of buffalo liver vegetable loaf incorporated with carrot paste. Similar findings were reported by Bhosale (2009) [11] who found that protein and fat contents of carrot-incorporated chicken nuggets did not vary significantly from control even up to a 15% level of incorporation. The addition of carrots in chicken patties had no significant (p>0.05) effect on the protein and fat content of chicken patties. However, a gradual decline in protein and fat content was observed as the incorporation of carrot levels increased. Similar findings were reported by Bhosale (2009) [11] who reported that protein and fat contents of carrot-incorporated chicken nuggets did not vary significantly from control even up to 15% level of incorporation, while control had highest fat and protein values. Brauer (1994) [10] also reported that fat and moisture content are very closely related in meat products and if fat content is low, the moisture content is likely to be high. Based on the results of sensory attributes and physico-chemical properties, 14% carrot-extended chicken patties were found to be optimum. Hence, it was selected for subsequent study.

Incorporation of Radish

Sensory Quality

The observations concerning quality attributes, as influenced by the incorporation of varying levels of radish (14, 18 and 22%) in the formulation of chicken patties, are presented in Table 3. It is observed that the sensory scores for all the quality attributes of chicken patties differed significantly (p<0.05) due to the incorporation of different levels of radish. Scores for appearance and flavour of the radish-incorporated chicken patties did not differ significantly (p>0.05) as compared to control up to 18% level. Among extended patties, 14% of radish extended patties recorded the highest scores for flavour as well as appearance. However, as the level of incorporation of radish increased beyond 18%, there was a significant decrease in the appearance and flavour of chicken patties. Present findings are in agreement with that of Shinde (2005) [3] who reported that the addition of radish paste up to 10% level did not cause any significant adverse changes in sensory attributes of pork patties. Sensory scores for juiciness, texture and overall palatability change significantly (p<0.05). Control had significantly (p<0.05) higher juiciness, texture and overall palatability score as compared to 18 and 22% radish extended patties. However, no significant difference was observed between the control and 14% radish extended chicken patties indicating that radish could be added in chicken patties formulation up to 14% level without adversely affecting its sensory quality. With further increase in the level of radish paste, the scores declined significantly (p<0.05) indicating that incorporation of a higher level (22%) of radish was not at all helpful. Similar findings were recorded by Sekhon and Bawa (1990) [3] for meat tikkas. Shinde (2005) [3] also reported that as the level of incorporation of radish in pork patties increased; there was a significant decrease in sensory scores of extended patties as compared to control.

Table 1: Effect of incorporation of carrot on sensory quality of chicken patties

Carrot level %	Sensory attributes				
	Appearance	Flavour	Juiciness	Texture	Overall palatability
Control	7.20 ^{a}±0.03	7.24^{a}±0.10	7.17^{a}±0.08	7.17^{a}±0.13	7.21^{a}±0.08
14	7.22 ^{a}±0.12	7.17^{a}±0.03	7.13^{a}±0.13	7.12^{a}±0.10	7.14^{a}±0.14
18	7.05 ^{a}±0.09	7.04^{b}±0.12	6.95^{b}±0.03	6.98^{b}±0.14	6.87^{b}±0.03
22	6.67 ^{b}±0.13	6.75^{c}±0.14	6.69^{c}±0.09	6.71^{b}±0.09	6.53^{c}±0.12

Means with common superscripts did not differ significantly (p<0.05).

Table 2: Effect of Incorporation of carrot on physicochemical characteristics of Chicken Patties

Carrot level %	Quality Parameters					
	pH	Emulsion stability (%)	Cooking yield (%)	Moisture (%)	Protein (%)	Fat (%)
Control	6.41^{a} ±0.03	96.57^{a} ±0.06	94.62 ^{a}±0.06	64.36^{a}±0.05	19.59±0.02	12.67±0.10
14	6.37^{a}±0.14	96.19^{a} ±0.10	94.27 ^{a}±0.11	65.71^{ab}±0.14	19.13±0.13	11.88±0.03
18	6.13^{ab}±0.10	94.86^{a}±0.14	93.26 ^{b}±0.03	66.69^{b}±0.07	18.77±0.10	11.36±0.14
22	5.99^{b}±0.02	91.10^{b}±0.11	92.89 ^{b}±0.14	67.26^{b}±0.10	18.31±0.06	10.94±0.09

Means with common superscripts did not differ significantly (p<0.05).

Table 3: Effect of incorporation of radish on sensory quality of chicken patties

Radish level %	Sensory attributes				
	Appearance	Flavour	Juiciness	Texture	Overall palatability
Control	7.19^{a}±0.09	7.14^{a}±0.13	7.23^{a}±0.07	7.19^{a}±0.13	7.21^{a}±0.04
14	7.13^{a}±0.04	6.99^{a}±0.05	7.03^{a}±0.03	7.08 ^{a}±0.11	7.10^{a}±0.08
18	6.84^{ab}±0.05	6.76^{ab}±0.03	6.71^{b}±0.15	6.81^{b}±0.02	6.59^{b}±0.15
22	6.59^{b}±0.09	6.34^{b}±0.11	6.26 ^{c}±0.08	6.57 ^{c}±0.09	6.11^{c}±0.07

Means with common superscripts did not differ significantly (p<0.05).

Table 4: Effect of the addition of radish on physicochemical characteristics of chicken patties

Radish level %	Quality Parameters					
	pH	Emulsion stability (%)	Cooking yield (%)	Moisture (%)	Protein (%)	Fat (%)
Control	6.32^{a}±0.005	95.61^{a}±0.12	95.18^{a} ±0.13	63.11^{a}±0.03	19.36±0.14	13.24±0.13
14	6.27^{a}±0.003	95.53^{a}±0.11	94.77^{a}±0.09	63.93^{a}±0.07	18.59±0.15	12.67±0.09
18	6.04^{b}±0.004	94.10 ^{b}±0.13	92.60^{b}±0.10	66.79^{b}±0.05	18.07±0.13	12.31±0.11
22	5.97^{b}± .003	93.49 ^{b}±0.15	91.49^{b}±0.16	67.42^{b}±0.04	17.84±0.11	11.47±0.08

Means with common superscripts did not differ significantly (p<0.05).

Physico-Chemical Properties

The data about physico-chemical characteristics of/ chicken patties incorporated with the Effect of incorporation of carrot on the sensory quality of chicken patties at different levels of radish are presented in Table 4. It is observed that the pH of chicken patties varied significantly with the incorporation of radish. The pH of control patties was 6.32 which decreased marginally but non significantly (p>0.05) to 6.27 in the 14% radish extended product. Among extended patties 18 and 22% had significantly lower pH values as compared to 14%. Grigelmo-Miguel *et al.* (1999) [7] reported that the addition of dietary fibre in meat product formulation lowered the pH (6.4 to 5.4) of the solution and thereby of the product pH. However, pH values of 18 and 22% radish-incorporated patties did not differ significantly (p>0.05). Similar findings were observed by Shinde (2005) [3] for pork patties. The emulsion stability of chicken patties differed significantly (p<0.05) due to the incorporation of radish. No significant gradual decline in emulsion stability was noticed from control to 14% radish-extended chicken patties. This indicated that up to 14% radish paste, there was no adverse effect on emulsion stability. Subsequent addition of radish paste decreased emulsion stability significantly. Shinde (2005) [3] observed that emulsion stability values were lower in extended patties than in control. Among extended patties, emulsion stability decreased significantly as the per cent level of radish paste increased in pork patties. Similar trends were observed for the cooking yield of chicken patties made by using different levels of radish. The highest cooking yield was observed in control which reduced gradually with the incorporation of 14% radish paste. As the level of incorporation of radish paste increased from 14 to 18%, the cooking yield decreased significantly. They indicated that a higher level of radish paste does not have a beneficial effect. The findings of the present investigation are almost similar to Shinde (2005) [3] who reported that cooking yield decreased as the per cent level of radish paste increased in pork patties. An increasing trend was observed for moisture content due to the incorporation of different levels of radish paste. Among radish-extended chicken patties 18 and 22% levels showed significantly (p<0.05) higher moisture content as compared to control patties and 14% radish level. Grigelmo-Miguel and Martin-Belloso (1997) [7] reported higher water content in meat products incorporated with fruit fibre. This might be due to the higher water retention capacity of these fibres, the soluble component of which mainly is pectin which may constitute up to 30% of the fibre's concentrate. It is observed from the table that the differences in protein and fat content of radish-extended chicken patties did not differ significantly (p>0.05) as compared to the control. The protein and fat content were observed to be decreased gradually with increased incorporation of radish. Brauer (1994) [10] reported that fat and moisture content are very closely related in meat products and if fat content is low, the moisture content is likely to be high. Based on the result of sensory attributes and physico-chemical properties, 14% of extended chicken patties were better in texture and juiciness with emulsion stability and cooking yield as compared to other extended patties. Thus 14% of radish paste as an extender in the preparation of chicken patties was selected for further study.

Summary and Conclusion

Acceptable quality chicken patties could be prepared with the incorporation of 14% carrot paste by replacing a proportionate quantity of meat. Chicken patties prepared with the incorporation of 14% radish paste were comparable to control patties. Results revealed that carrot and radish paste can be used as extenders in chicken patties formulation without any adverse effect on the quality and sensory properties of chicken patties.

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