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Effect of Carrot Powder on the Quality Attributes of Fibre-Enriched Spent Hen Meat Cutlets

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ABSTRACT

The present study was envisaged to develop fibre-enriched chicken meat cutlets with the incorporation of carrot powder. Chicken meat cutlets incorporating four levels of carrot powder viz. 0% (control), 2.0 % (T1), 4.0% (T2) and 6.0% (T3), were prepared by replacing lean meat with carrot powder in the basic formulation of chicken meat cutlets. The developed cutlets were evaluated for various parameters such as proximate, physico-chemical, instrumental texture and colour profile, and sensory attributes. The moisture, dietary fibre, cooking yield increased significantly (P<0.05) whereas fat content decreased significantly with the increasing levels of carrot powder. The dimensional parameters were better maintained in the treated groups than control. Hardness value of the cutlet increased significantly (P<0.05) upon the incorporation of carrot powder and the values for T2 and T_3 were significantly higher (P<0.05) than T1. Increasing trend was also observed in *a** values with increase in the incorporation level of carrot powder which might be due to red colour of carrot powder. The overall acceptability scores of the chicken meat cutlet with 4% carrot powder was significantly (P<0.05) higher than control and other treatment products.

Keywords: Chicken meat cutlets, fibre enrichment, carrot powder, dietary fibre

There is a rapid increase in production as well as consumption of fast foods worldwide due to urbanization, changing food habits and lifestyles, women's engaged in outdoor jobs, increasing interest of school going children in snack foods, portability etc. (Verma *et al.* 2013). Snack foods are ready to eat convenient food items preferably eaten in between regular meals for the purpose of satisfying hunger, providing nutrition and energy. Amongst the snack foods, cutlets are one of the most popular snack items in Asian countries after biscuit due to its spicy and unique taste. Cutlets are served as delicacies and widely served as part of breakfast in restaurants, fast food outlets, air/railway catering services (Singh *et al.* 2014a;b). Cutlets are mostly cereal based, usually prepared as ready to eat, served warm, alone or with sauces. The nutritive value of cutlets can be further enhanced by incorporating animal protein in the form of meat, fish etc. The incorporation of chicken meat in snack based food will not only increase the nutritive value of cutlets but will certainly provide the poultry industry of India and the world with an alternate sector for value addition of chicken meat (Verma *et al.* 2014; 2013; 2012).

Meat cutlets are inherently low in dietary fibre and unable to fulfill the daily requirement for the average person. The RDA (recommended dietary allowance) of dietary fibre is 35 g and 25 g in adult male and females respectively (Mehta *et al.* 2015; Kumar *et al.* 2013).These fried products also contain high levels of fat and are prone to auto oxidation resulting in warmed over flavors. Thus incorporation of fruits and vegetables, which are the source of natural antioxidants and rich in dietary fibre, could issmprove the functionality and reduce the cost of production. Incorporation of dietary fibre source in meat products resulted in increasing the nutritive quality by cooking yield, replacing fat, lowering blood sugar levels, providing a non-calorie bulking agent that can aid in weight loss by replacing calorie food components such as fat as well as organoleptic properties such as texture, juiciness and overall acceptability of meat products (Singh *et al.* 2015).

Carrot is one of the important widely consumed root vegetables, a rich source of beta carotene, iron, pectin, dietary fiber, minerals etc. Carrot is known as a source of carotenoids and phenolic compounds, which inhibits the lipid oxidation (Soria *et al.* 2009). The effect of ground raw carrot and mashed sweet potato as functional ingredients on the quality of chicken meat nuggets was studied by Bhosale (2009) and reported higher cooking yield, emulsion stability, improved nutritional, sensory and textural properties. They also reported that incorporation of carrot and sweet potato at 10% added level have greater potential as good source of dietary fibers and b-carotene and may find their way in meat industry. The incorporation of boiled carrot (100g / kg meat) has been reported to improve colour, texture and nutritive value of beef patties whereas, carrot powder improved cooking yield, colour, texture and vitamin A content (Saleh and Ahmed, 1998). Incorporation of 2% carrot and 10% spinach in poultry hamburger resulted in improved oxidative stability (Pizzocaro *et al.* 1998). Therefore, the utilization of carrot in meat products as a source of dietary fibre could be a novel approach to improve the functionality meat products.

Thus the present study was undertaken to evaluate the effect of carrot powder in the development of fibre enriched chicken meat cutlets.

MATERIALS AND METHODS

Source of materials

The spent layer birds (White Leghorn) were procured from poultry farm of Department of Livestock Production and Management, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab and were slaughtered scientifically in the experimental slaughterhouse of the Department. The dressed carcasses were hot deboned manually, fascia, external fat and other connective tissue were removed and the deboned meat was packaged in low density polyethylene film (LDPE) bags and stored overnight in a refrigerator at (4±1°C)for conditioning and then stored at -18±1°C for subsequent use. The frozen deboned meat were drawn as per requirement and thawed overnight in a refrigerator (4±1°C) and were used for further study.

The ingredients for spice mix were procured from local market, cleaned, dried and grinded to fine powder. The spice mix was prepared by mixing different spices ingredient as per the pre standardized formulation developed in laboratory as per Verma *et al.* (2015). Fresh carrot were procured from local market, washed with clean water and sliced into small pieces. The sliced carrot was heated dried in hot-air oven at 60°C to a moisture level of less than 8%. The dried carrot was ground in a grinder (Inalsa, India) to make fine powder. The

Table 1: Formulation for preparation of chicken meat cutlet incorporating carrot powder

Name of ingredients (% w/w)	Control	Treatments		
		T1	T2	T3
Chicken meat (Minced)	71.0	69.0	67.0	65.0
Carrot powder	—	2.0	4.0	6.0
Cooked shredded potato	10.0	10.0	10.0	10.0
Condiment mix (3:1:1)	10.0	10.0	10.0	10.0
Refined Oil	2.0	2.0	2.0	2.0
Salt	1.5	1.5	1.5	1.5
Red chilli powder	0.5	0.5	0.5	0.5
Spice mix	2.0	2.0	2.0	2.0
Binder	3.0	3.0	3.0	3.0

Table 2: Proximate composition of chicken meat cutlets with different levels of carrot powder (Mean±S.E.)

Composition (%)	C	T1	T2	T3
Moisture	58.80±0.54[a]	59.21±0.45[a]	60.68±0.63[b]	61.05±0.48[b]
Fat	16.41±0.10[d]	15.32±0.18[c]	14.78±0.11[b]	14.18±0.12[a]
Protein	11.45±0.22	11.34±0.18	11.26±0.32	11.07±0.19

n=6, C= Control (without carrot powder); T_1= 2% carrot powder, T_2= 4% carrot powder, T_3= 6% carrot powder. *Mean±S.E. with different superscripts row-wise differ significantly (P<0.05).

condiment mix was prepared by mixing onion, ginger and garlic paste, respectively in 3:1:1 ratio. Bread crumbs and whole egg liquid were used as breading and battering material.

Methodology for Preparation of chicken cutlets

Meat was minced through 6 mm plate in meat mincer (Mado Eskimo Mew-714, Mado, Germany). The condiments, cooked shredded potato, spice mix, refined oil, salt, red chillies, refined wheat flour was added as per the formulation (Table 1) in the minced meat. The carrot was incorporated in the cutlet formulation at four different levels viz. 0% (Control), 2.0 % (T1), 4.0% (T2) and 6.0% (T3) by replacing lean meat. For the preparation of meat cutlet, four batches (one control and three treatments) of batter were prepared by thoroughly mixing all the ingredients. The chicken meat batter obtained was moulded (oval shaped) using a mould of dimensions of 59 × 40 ×18 mm, length, breath and height respectively. The cutlets were then cooked in hot air oven at 175°C for 15 minutes, with turning once after ten minutes, and then cooled after cooking. Cutlets were dipped into whole egg liquid and were rolled over the bread crumbs until uniform coating of breading material was formed over it. The breaded cutlets were shallow fried in refined oil at 140-150°C, until golden brown color is developed on the surface. The fried cutlets were cooled, weighted, packed and put for further analysis.

Proximate analysis

Moisture (oven drying), protein (kjeldahl distillation), fat (soxhlet method) and ash (muffle furnace) and fibre content of samples were determined by using standard procedure described by AOAC (2000).

Physico-chemical analysis

Cooking yield of the samples was determined by measuring the difference in the sample weight before and after cooking (Murphy *et al.* 1975).

$$\text{Cooking yield (\%)} = \frac{\text{weight of cooked meat cutlets}}{\text{weight of uncooked cutlets}} \times 100$$

The pH of product was measured as per the procedure of Trout *et al.* (1992) using combined glass electrode of Elico pH meter (Model LI 127).

The dimensional parameters of the cutlets were measured by vernier calliper at three different places. The percent gain in height and decrease in breath/length percent were determined according to equations of Verma *et al.* (2015).

$$\text{Decrease in breath/length (\%)} = \frac{\text{Breath/length of uncooked cutlet- Breath/length of cooked cutlet}}{\text{Breath/length of uncooked cutlet}} \times 100$$

$$\text{Gain in height (\%)} = \frac{\text{Cooked cutlet height- Uncooked cutlet height}}{\text{Uncooked cutlet height}} \times 100$$

Colour profile was measured using Lovibond Tintometer (Model: RT-300) set at 2° of cool white light (D65) and known as 'L', a, and b values. 'L' value denotes (brightness 100) or lightness (0), a (+ redness/-greenness), b (+ yellowness/-blueness) values. The instrument was calibrated using a light trap (black hole) and white tile provided with the instrument. The instrument was directly put on the surface of cutlets at different points.

Texture profile analyses (TPA) of products were performed using a Texture Analyser (TMS-PRO, Food Technology Corporation, USA) following the procedures of Bourne (1978). The samples were cut into uniform cube size of 1.0×1.0×1.0 cm and subjected to double compression cycle to 50% of their original height. The following parameters were determined using software (TMS-Pro): Hardness (N cm^{-2}) = maximum force required to compress the sample (H); Springiness (cm) = ability of sample to recover its original form after a deforming force was removed (S); Cohesiveness = extent to which sample could be deformed prior to rupture (A2/A1, A1 being the total energy required for first compression and A2 the total energy required for the second compression); Gumminess (N cm^{-2}) = force necessary to disintegrate a semisolid sample for swallowing (H×Cohesiveness); Chewiness (N cm^{-1}) = work to masticate the sample for swallowing (S×Gumminess).

Sensory evaluation

A seven member experienced panel comprising of scientists and postgraduate students of the department evaluated the samples for the attributes viz. appearance and colour, flavour, texture, juiciness and overall acceptability using 8 point descriptive scale (Keeton, 1983), where 8=extremely desirable and 1=extremely undesirable. The panelists were seated in a room free of noise and odours and suitably illuminated with natural light. Coded samples at a temperature of 37°C were served to the panelists. Potable water was provided in between samples to cleanse the mouth palate.

Statistical analysis

The data obtained from various trials under each experiment were subjected to statistical analysis (Snedecor and Cochran, 1994) for Analysis of Variance (ANOVA) and Duncan's multiple range test (DMRT) to compare the means by using SPSS-16 (SPSS Inc., Chicago, IL,USA). Each experiment was replicated six times. The level of significant effects, least significant differences were calculated at appropriate level of significance was taken as 5%.

RESULTS AND DISCUSSION

Proximate composition

The proximate composition of chicken cutlets incorporated with carrot powder is presented in Table 2. Moisture content of increased with the increasing levels of carrot powder in chicken cutlets. This might be due the better moisture retention by the treated products due to better water holding capacity of the innate fibre which is naturally present in carrot. Similar results were also reported by Devatkal *et al.* (2004) in buffalo meat, liver and vegetable loaves. Werner *et al.* (2002) also reported the increased water binding capacity of pork sausages upon addition of carrot fibre. Protein content of the treated products was lower than control irrespective of the incorporation carrot. This could be

Table 3: Physico-chemical quality, instrumental texture, colour profileand sensory quality of chicken meat cutlets with different levels of carrot powder (Mean±S.E.)*

		Levels of carrot powder (%)		
	Control	T_1 (2)	T_2 (4)	T_3 (6)
Product pH	6.15±0.05	6.16±0.007	6.16±.005	6.16±.006
Cooking yield (%)	86.39±0.36^{a}	87.38±0.19^{b}	90.67±0.25^{c}	90.75±0.26^{c}
Water activity (a_w)	0.983±0.001^{c}	0.978±0.002^{b}	0.972±0.001^{a}	0.971±0.002^{a}
Increase in height (%)	57.33±0.90^{a}	64.06±1.84^{b}	66.35±1.52^{b}	68.73±1.95^{b}
Decrease in length (%)	16.95±0.08^{c}	12.13±0.05^{b}	10.97±0.18^{a}	10.63±0.15^{a}
Decrease in breadth (%)	16.62±0.83^{c}	13.25±0.45^{b}	13.02±0.53^{b}	10.94±0.2^{a}
Instrumental texture profile				
Hardness (N)	8.93±0.16^{a}	9.95±0.19^{b}	11.59±0.20^{c}	12.92±0.27^{d}
Springiness (mm)	27.05±0.65	27.81±0.46	27.46±0.89	27.69±0.35
Stringiness (mm)	23.05±1.38	22.07±1.52	22.52±0.99	25.55±0.95
Cohesiveness	0.68±0.02	0.73±0.01	0.74±0.03	0.75±0.01
Chewiness (J)	162.59±2.61^{a}	166.70±2.36^{a}	165.89±6.58^{a}	183.42±4.21^{b}
Gumminess (N)	6.55±0.453	7.13±0.60	6.99±0.34	7.08±0.41
Resilience	0.66±0.02^{a}	0.71±0.02^{ab}	0.73±0.03^{ab}	0.76±0.02^{b}
Instrumental colour profile				
*L** Lightness	44.47±0.47	40.22±1.59	43.86±1.40	40.54±1.79
*a** Redness	12.15±0.37^{a}	13.33±0.51^{b}	13.52±0.51^{bc}	14.54±0.19^{c}
*b** Yellowness	23.44±0.79^{a}	23.55±0.98^{a}	26.16±0.53^{b}	25.76±0.57^{b}
Sensory scores				
Appearance/colour	6.25±0.11^{a}	6.41±0.15^{a}	7.33±0.10^{b}	7.18±0.10^{b}
Flavour	6.33±0.10^{b}	6.75±0.21^{b}	7.42±0.08^{c}	5.42±0.32^{a}
Juiciness	6.08±0.08^{a}	6.33±0.10^{a}	7.25±0.11^{b}	7.08±0.08^{b}
Texture	6.36±0.00^{a}	6.75±0.17^{b}	6.75±0.11^{b}	6.66±0.10^{b}
Overall acceptability	6.28±0.08^{a}	6.80±0.01^{b}	7.25±0.17^{c}	7.00±0.11^{b}

n=6, C= Control (without carrot powder); T_1= 2% carrot powder, T_2= 4% carrot powder, T_3= 6% carrot powder. *Mean±S.E. with different superscripts row-wise differ significantly (P<0.05) due to the low protein content of the carrot powder and higher moisture level in treated products. Similar findings were also reported in cooked burgers incorporated with passion fruit albedo by Lopez-Vargas *et al.* (2014). Fat content decreased significantly (P<0.05) in carrot powder incorporated cutlets than control. It might be due to lower fat in carrot and higher moisture in treated groups. This finding was in accordance with Verma *et al.* (2014) in jackfruit incorporated chevon patties. The crude fibre content of the carrot powder incorporated chicken meat cutlets were higher significantly (P<0.05) than control. This might be due to higher crude fibre content in the carrot powder. Similar results were also reported by Kumar *et al.* (2015) in chevon patties. Ash content of the treated samples was significantly higher than control due to higher mineral content in carrot powder.

Physico-chemical quality

The results for physico-chemical quality of spent hen meat cutlets incorporated with three different levels of carrot powder viz. 2% (T1), 4% (T2) and 6% (T3) by replacing the lean meat are presented in Table 3. The pH values of cooked spent hen meat cutlets were comparable among control and treatment products, which could be due to the neutral pH of added carrot powder. Significant (P<0.05) increase in cooking yield (CY) was observed in chicken meat cutlets incorporated with carrot powder than control. The CY for T2 and T3 were comparable but it was significantly (P<0.05) higher than T1 and control. This increase in cooking yield might be due to improved water binding property of added powder. Similar findings have also been reported by Mendiratta *et al.* (2013) in mutton patties. The water activity (a_w) decreased significantly (P<0.05) upon incorporation of carrot powder and the values for T2 and T3 were comparable among each other but significantly lower than T1.

The dimensional parameter especially degree of shrinkage is considered as an indicator for maintenance of quality of chicken meat cutlet (Das *et al.* 2008). The dimensional parameters viz. decrease in breadth/length (shrinkage percent) and increase in height was improved significantly (P<0.05) in treated products. The percent gain in height increased significantly (P<0.05) with the increase in level of incorporation of carrot powder in the products. The dimensional parameters were better maintained in the chicken meat cutlets incorporated with carrot powder than control. This might be due to higher content of carrot powder attributed to higher water holding capacity, better moisture retention, increased cooking yield. Similar findings of improvement of dimensional parameters of meat products upon incorporating fibre source has also been reported by Mehta *et al.* (2015), Kumar *et al.* (2015) and Verma *et al.* (2015).

Instrumental Texture and colour profile analysis

Hardness value of the cutlet increased significantly (P<0.05) on incorporation of carrot powder and the values for T_2 and T_3 were significantly higher (P<0.05) than T1 (Table 3). The chewiness values of T_3 were significantly higher (P<0.05) than control, but an increasing trend was noticed on higher level of incorporation of carrot powder. The other texture profile parameters viz. stringiness, springiness, cohesiveness, gumminess and resilience values were comparable for all the treatments and control products. The L^* values for the treated products were comparable with control. Increasing trend was observed in a^* values with the increase in the incorporation level of carrot powder, which might be due to red colour of carrot powder. T_3 product with 6% carrot powder had significantly higher (P<0.05) a^* value than control and T_1. The b^* value for the treatment products T2 and T3 were comparable to each other, but significantly (P<0.05) higher than control and T1 products.

Sensory evaluation

The sensory panelists awarded higher scores for appearance and colour to the treated products than control and the scores for T2and T3 were significantly (P<0.05) higher than control and T1 products (Table 3). This increase in appearance score is reflected in redness values of the respective products. The carrot powder incorporation has improved the appearance and colour. The results are in conformity to the instrumental colour profile. The flavour, juiciness, texture and overall acceptability scores for T2 were significantly (P<0.05) higher than control. The increase in juiciness could be due to the increase in water holding capacity of products due to presence of millet starch (Talukdar and Sharma, 2013). The overall acceptability scores of the chicken meat cutlet with 4% carrot were very good to excellent quality.

CONCLUSION

On the basis of different physico-chemical, dimensional, textural, colour and sensory properties chicken meat cutlets incorporated with 4% carrot powder by replacing the lean meat in the standardized formulation was found most suitable.

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