Journal of Animal Research: v.5 n.3, p. 455-459. September 2015

DOI: 10.5958/2277-940X.2015.00078.9

Comparative Efficacy of Different Binders in the Development of Chicken Meat Cutlets

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Received: 03 May, 2015 **Accepted:** 03 June, 2015

ABSTRACT

Present study was envisaged to assess the efficacy of different binders viz. 3% refined wheat flour (T1) and 3% rice flour (T2) replacing lean meat in the preparation of chicken meat cutlets. The developed products as well as control were assessed for various physico-chemical, instrumental texture and colour profile, and sensory evaluation. *L** values were comparable for T1 and T2 but were significantly (P<0.05) lower than control. The hardness values differ significantly (P<0.05) in treatments than control and recorded highest for T2 and lowest for control. The springiness of the T1 was significantly (P<0.05) higher as compared to T2 but was comparable to control. The juiciness score were significantly (P<0.05) higher for treatments as compared to control. Overall acceptability of cutlets with refined wheat flour (T1) was significantly (P<0.05) higher than control and comparable with T2. Thus it can be concluded that chicken cutlet with 3% refined wheat flour was found optimum.

Keywords*:* Cutlets, binders, rice flour, refined wheat flour, quality attributes

Snack foods are ready-to-eat/ prepare (RTE/RTP) convenient food items that are eaten other than regular meals for the purpose of refreshment, energy and satisfying hunger for short term. At present, the demand of these snacks foods are increasing day by day due to urbanization, industrialization, changes in socio-economic conditions such as increasing working women, nuclear family etc. Cutlets are flat croquette of minced meat, flour, pulse, nuts, potato, condiments, spices and often coated with bread rusk crumbs and are one of the most popular snack based products (Singh *et al.*, 2014a;b). The nutritive and functional value of cutlets can be further enhanced by incorporating animal protein.

Meat cutlets are ready-to-eat convenient meat product, served hot, with or without sauce/ chutney. These products are energy dense, fried and deficient in dietary fibre. The cooking yield is also low and there is problem in binding in final product case of incorporation of meat with high connective tissue such as meat of spent animals. So there is increasingly incorporation of ingredients that are important for increasing binding and other functional properties of meat cutlets. Such ingredients are known as binders and are widely used to improve emulsion stability, cooking yield, slicing ability and flavour in addition to decrease formulation cost of meat cutlets. The common binders used in meat industry are refined wheat flour, rice flour, legume flour, potato starch etc.

Generally consumers prefer meat products with slight to moderate binders over full-meat products. Binders/fillers like starches, flours and potato increases the juiciness of the product by better water retention in the products at 50^0C -70^0C (FAO). Chetna *et al*. (2014) formulated chicken cutlets with potato as binder and reported 25% potato levels in binder as optimum. Singh *et al*. (2014b) also reported 5% shredded potato levels optimum in preparation of chevon cutlets. Singh *et al*. (2015) reported improved organoleptic properties of chevon patties with the incorporation of oat quakers. Ahmad *et al*. (2007)

reported buffalo meat cutlets incorporated with refined wheat flour had significantly higher protein and fat content and also higher overall acceptability followed by corn flour, potato starch and tapioca flour. Higher cooking yield was recorded for cutlets with 20 percent meat emulsion. The effect of different binders such as corn starch, wheat semolina, wheat flour and tapioca starches on the physico-chemical, textural, histological, and sensory qualities of retorts pouched buffalo meat nuggets was studied by Devadason *et al*. (2010) and reported that corn flour is the better cereal binder for developing buffalo meat nuggets. Verma *et al*. (2015b) also reported improved economics and organoleptic properties of developed functional pork loaves upon incorporation of inulin. Verma *et al*. (2012) reported that the superior nutritive value of rice flour above wheat and soy due to presence of certain amino acids as phenylalanine, leucine and isoleucine. The incorporation of rice flour in processed meat products have been reported to improve texture, flavour and colour of products. There studies on utilization of rice flour are very inconclusive and limited.

Thus the present study was undertaken to evaluate the effect of refined wheat flour and rice flour in the development of chicken meat cutlets

MATERIALS AND METHODS

Source of materials

The White Leghorn layer birds of 58-60 weeks old (spent hen) 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. The dressed carcasses were hot deboned and stored overnight in refrigerator (4±1ºC) in low density polyethylene film (LDPE) bags for conditioning followed by storing at -18±1ºC for subsequent use. The frozen deboned meat was thawed overnight in a refrigerator (4±1ºC) and was 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.* (2015a). The 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

Lean meat was minced through 6 mm plate in meat mincer (Mado Eskimo Mew-714, Mado, Germany) and condiments, cooked shredded potato, spice mix, refined oil, salt, red chillies, refined wheat flour was added in it as per the formulation (Table 1). In the standardized formulation, lean meat was replaced by 3% refined wheat flour (T1) and 3% rice flour (T2) replacing lean meat. For the preparation of meat cutlet, three batches (one control and two treatments) of batter were prepared by thoroughly mixing all the ingredients including meat emulsion. The chicken meat batter obtained was moulded (oval shaped) using a mould of dimensions of 58 × 41 ×19 mm, length, breath and height respectively. The cutlets were then cooked in pre-heated hot air oven at 175ºC for 15 minutes, with turning once after ten minutes. Cutlets were cooled and dipped into whole egg liquid until uniform coating is formed. The battered cutlets were rolled over the bread crumbs until uniform coating of breading material was formed over it. The breaded cutlets were shallow fried at 140-150ºC, until golden brown color is developed on the surface. The fried cutlets were cooled, weighted, packed and put for analysis.

Physico-chemical analysis

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

The pH of chicken meat cutlet 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 cutlets were measured by vernier calliper at three different places. The percent gain in height and decrease in breath/length percent were determined as per the following equation-

Water activity was determined using potable digital water activity meter (Rotronix HYGRO Palm AW1 Set, Rotronix Instrument (UK) Ltd., West Sussex, UK). Briefly, finely ground meat cutlets were filled up (80%) in a moisture free sample cup. The sample cup was placed into the sample

Table 1: Formulation of chicken meat cutlets.

Name of ingredients (Percentage w/w)	Control	T1	T2
Chicken meat (Minced)	71.0	68.0	68.0
Cooked shredded potato	10.0	10.0	10.0
Condiment mix (3:1:1)	10.0	10.0	10.0
Refined Oil	2.0	2.0	2.0
Salt	1.5	1.5	1.5
Red chilli powder	0.5	0.5	0.5
Spice mix	2.0	2.0	2.0
Refined wheat flour	3.0	6.0	3.0
Rice flour	-	-	3.0

Table 2: Physico-chemical quality, instrumental texture and colour profile of chicken meat cutlets incorporated with RWF (maida) and Rice flour (Mean ± S.E.*)

Parameters	Control	RWF (T_1)	Rice flour (T_2)
Physico-chemical parameters			
Product pH	6.15± 0.004	6.15±0.01	6.16±0.05
Cooking yield (%)	80.31±0.81^a	89.13±2.28^c	82.30±2.33^b
Water activity (a_w)	0.984±0.001	0.982±0.001	0.981±0.002
Dimensional parameters			
Decrease in length (%)	16.95±0.95^c	12.12±0.14^b	11.25±0.32^a
Decrease in breadth (%)	12.04±0.38^b	5.05±2.16^a	5.95±1.83^a
Increase in height (%)	51.86±0.33^a	65.49±1.02^b	55.63±0.81^a
Instrumental texture profile			
Hardness (N)	10.83±0.52^a	12.98±0.89^b	15.30±0.59^c
Springiness (mm)	26.79±1.98^{ab}	28.31±0.39^b	25.46±1.02^a
Stringiness (mm)	20.99±1.11^a	25.05±0.79^b	24.89±1.20^b
Cohesiveness	0.78±0.01	0.77±0.02	0.69±0.05
Chewiness (J)	117.43±3.70^a	134.67±3.87^b	163.76±3.64^c
Gumminess (N)	4.53±0.81^a	5.57±0.50^b	6.13±0.47^b
Resilience	0.80±0.01	0.71±0.04	0.84±0.03
Instrumental colour profile			
*L** Lightness	40.25±1.06^b	37.47±0.58^{ab}	36.46±1.39^a
*a** Redness	15.03±0.40	14.49±0.40	14.22±0.32
*b** Yellowness	22.26±1.03	23.21±0.40	21.45±3.18

n=6; C= Control (without binder); T_1= 3% Refined wheat flour, T_2= 3% Rice flour *Mean±S.E. with different superscripts in row-wise differ significantly (P<0.05)

holder, and then sensor was placed on it for five min for a_w value. Duplicate reading was performed for each sample.

Colour profile was measured using Lovibond Tintometer (Model: RT-300). '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. Then the above colour parameters were selected. The instrument was directly put on the surface of meat cutlets at different points.

Texture profile analysis (TPA) of sample was 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 using pre-test speed was 5mm/s, test speed was 1mm/s, post-test speed was 1mm/s, distance was 10mm and exposure time was 3 sec. 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 twelve member experienced panel comprising of scientists and postgraduate students evaluated the samples for the attributes viz. appearance, 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. The 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

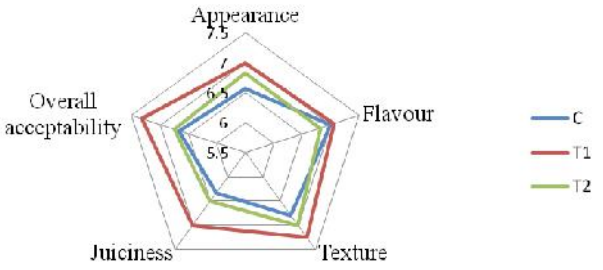

Figure 1. Sensory scores of chicken meat cutlets incorporated with different binders

C= Control (CMC without binder); T_1= CMC with 3% Refined wheat flour, T_2= CMC with 3% Rice flour *Mean±S.E. with different superscripts in row-wise differ significantly (P<0.05)

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% for a pair-wise comparison of treatment means.

RESULTS AND DISCUSSION

Physico-chemical quality

No significant difference was observed in pH values of control and treatments (Table 2). It might be due to neutral nature of refined wheat flour and rice flour. These findings were in accordance with the findings of Ahmed *et al*. (2007) who also reported no change in pH with the addition of different binders in buffalo meat cutlets. Cooking yield varied significantly (P<0.05) in treatments as compared to control (Table 2). It must be due to ability of binders to hold the moisture while cooking. Singh *et al*. (2014a) also reported increase in cooking yield of chicken cutlets upon oat quaker and potato. Cooking yield of RWF incorporated cutlets (T1) was significantly (P<0.05) higher than rice flour (T2) and control. These findings were similar to Ahmed *et al.* (2007) who also reported increased product yield upon addition of starch in buffalo meat cutlets. Water activity decreased upon addition of binders which could be due to binding of more water in flours and thus leaving comparatively lower water available for microorganisms to grow. Similar findings have also been reported by Kumar *et al*. (2015) in chevon patties upon incorporation of finger millet flour.

The dimensional parameters of cutlets play very important role in consumer acceptance and marketing. Therefore, change in dimension should be considered while evaluating the efficacy of different binders/ fillers in the preparation of meat cutlets. The dimensional parameters viz. percent decrease in breadth/length and increase in height were better maintained in the treatments as compared to control. The increase in height increased significantly for T1 as compared to control and T2. The percent increase in height increased linearly with the incorporation of binders in chicken meat cutlets formulation as compared to control. It is attributed to the swelling nature of chicken meat cutlets due to better water retention by binders in treatments. Similar findings have also been reported by Singh *et al*. (2015) and Raja *et al*. (2015) in chevon cutlets upon adding oat, sorghum and shredded potato and fish curls upon adding legume flours respectively.

Instrumental texture and colour profile analysis

The hardness value differ significantly (P<0.05) in treatments and control and recorded highest for T2 and lowest for control (Table 2). The springiness of T1 was significantly (P<0.05) higher than T2, but was comparable to control. The stringiness and gumminess values were comparable for treatments but were significantly (P<0.05) higher than control. The chewiness differ significantly (P<0.05) in treatments as well as control and recorded highest in T2. This could be due to incorporation of flour of hard wheat (*Triticum aestivum* L.) is the main primary ingredient and the addition of alkaline salts helps in strengthening the structure and hence improves the firmness of the final product (Verma *et al.*, 2013).

*L** values were comparable for T1 and T2 but were significantly (P<0.05) lower than control. It might be due to reduction of colour because of addition of flour. The decrease in *L** and *a** upon incorporating binders could be due to the innate colour of flours due to high contents of starch, which turned brown on cooking due to Maillard reaction. Similar findings have also been reported by Kumar *et al*. (2015) in chevon patties upon adding finger millet flour. Naveena *et al*. (2005) also reported that lower

lightness in rice flour incorporated meat products. Redness (*a**) and Yellowness (*b**) values were comparable for control as well as treatments.

Sensory evaluation

No significant difference was observed in appearance, flavor and texture scores of treatments and control, whereas the juiciness scores were significantly ($P<0.05$) higher for treatments as compared to control (Figure 1). A higher but non-significant juiciness scores were observed in T1 as compared to T2. This might be due to higher moisture retention by the flours in treated products. Overall acceptability of cutlets with refined wheat flour (T1) was significantly ($P<0.05$) higher than control and comparable with T2. These findings were in consonance with the observations of Ahmed *et al.* (2007).

CONCLUSION

Thus it can be concluded that chicken cutlet with 3% refined wheat flour (T1) was found better than chicken cutlet with 3% rice flour (T2) based on physico-chemical, instrumental colour and texture and sensory attributes.

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