Original Research

Quality Evaluation of Low-Fat Chicken Patties Incorporated with Different Fat Replacers

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Abstract

The present investigation was conducted to evaluate quality of low-fat chicken patties incorporated with different natural fat replacers. Low fat chicken patties were prepared by replacing 50% fat in the formulation by incorporating 1% lemon albedo, 2% mango peel and 2% banana peel powder as fat replacers. Control had significantly (P<0.05) higher emulsion as well product pH, emulsion stability, fat content, cholesterol content than treatment, however 1% lemon albedo powder added patties had highest mean cooking yield, moisture content, fat retention, water activity and moisture retention. Mineral content and color parameters showed significant (P<0.05) effect on addition of different fat replacers. In present study, sensory scores of most of the attributes of 1% lemon albedo powder was comparable to the control and significantly (P<0.05) higher than 2% mango peel and 2% banana peel powder added patties except saltiness and juiciness. Therefore, 1% lemon albedo was observed to be suitable as fat replacer for producing low fat chicken patties.

Key words: Banana Peel, Fat Replacers, Low Fat Chicken Patties, Lemon Albedo, Mango Peel

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Introduction

Meat has exerted a crucial role in human evolution, as it is a source of good nutrients, viz, high biological value protein, essential amino acids, vitamins and minerals. India ranks fifth in worlds meat production with 7.4 million tons production, which contributes 2.23% of the world's total production of 330.4 million meat tons (FAO, Food outlook, 2017). Recently peoples prefer variety of meat products viz, cured meats, patties, nuggets, meatballs etc. Patty is a finely comminuted emulsion-based meat product, exhibits

industrial as well as economic importance, and which is mainly affected by the raw material quality and composition (Turhan *et al.*, 2005). Fat is a very important ingredient which effect on sensory characteristics (Jiménez-Colmenero, 2000) and technological aspects of the product (Hughes *et al.*, 1997). Patties containing fat content lower than 20g/100g usually exhibit rubbery texture therefore, 20-30g of fat/100g is necessary to prepare patty without affecting its quality (Angor and Al-Abdullah, 2010). However, product with high fat content may exerts obesity and high blood cholesterol levels (Chau and Huang, 2004). Therefore, reduction fat content of product without affecting its quality may be a significant challenge. Fat replacers could be used for fat reduction, which has fat resembling compounds with altered digestibility and nutritional values (ADA, 2005).

Lemon is an important medicinal plant of the family *Rutaceae*. Lemon albedo is a white, spongy and cellulosic tissue of the lemon peel. It is a potential source of fiber, which improves functional properties of meat products (Fernandez-Gines *et al.*, 2004). Banana (*Musa sapientum*) is a very popular fruit because of its low price and presence of high nutrients. However peel or skin of banana is thrown as waste product, in verity it contains 43–49g of total DF, 1g of inulin, 6g of fructooligosaccharide and 10–20g of pectin per 100g of dry matter, in addition to significant amounts of α-linolenic acid (ALA), essential amino acids and micronutrients such as Mg, K, P and Ca (Mohapatra *et al.*, 2010). The mango is indigenous fruit representing approximately 20% peel, which is an excellent source of nutrients and nutraceutical compounds which could be used to generate economic profit in the food industry (Thomas *et al.*, 2013). Therefore, the study was aimed to develop low fat chicken patties with addition of natural fat replacers.

Materials and Methods

The required quantity of raw chicken meat was procured from authorized retail meat shop of Mathura within 1-2hrs of slaughter, packed in pre sterilized LDPE bags and brought to the laboratory within 20 min. The meat was deboned, trimmed-off separable fat and connective tissue. The samples were kept for conditioning in a refrigerator at 4±1°C for 6–8 hrs and then frozen at -18°C till further use. Various spices, condiments (onion, ginger, and garlic), oil, salt, lemon, mango, banana were purchased from local market of Mathura. All the chemicals used in the study were of analytical grade and obtained from standard firms

Fruit Peel and Lemon Albedo Powder

Fruits peel and lemon albedo was cut into small pieces, dried in hot air oven at 50±2°C for 48hrs, ground into fine powder, then tightly sealed in LDPE pouches and stored at 4±1°C till further use (Fernández-Ginés *et al.*, 2003).

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Preparation of Chicken Patties

The chicken patties were prepared as per method followed by Nayak *et al.* (2015). Frozen deboned meat was thawed at 4±1˚C, cut into smaller chunks and minced in meat mincer with 6mm plate followed by 4mm plate. The emulsion was prepared in bowl chopper with addition of salt, STPP, water, refined vegetable oil, spice mixture, condiments and other ingredients as per formulation mentioned in Table 1. About 50g of emulsion was moulded on steel plate with circular ring (55mm diameter and 20mm height), cooked in a pre-heated convection oven at 160°C for 15 minutes before turning and 5 min after turning for adequate doneness.

Table 1: Formulations of low-fat chicken patties incorporated with different natural fat replacers

S. No.	Ingredients	% of mix			
		Control	LA1	MP2	BP2
1	Lean chicken meat	74.2	74.2	74.2	74.2
2	Refined vegetable oil	8	4	4	4
3	Ice flakes	8	11	10	10
4	Salt	1.5	1.5	1.5	1.5
5	Spice mix	2	2	2	2
6	Condiment	3	3	3	3
7	Refined wheat flour	3	3	3	3
8	STTP	0.3	0.3	0.3	0.3
9	Natural fat replacers	0	1	2	2

Control (C)- Chicken patties without fat replacer, LA1- Chicken patties with 1 % lemon albedo powder, MP2- Chicken patties with 2 % mango peel powder, BP2- Chicken patties with 2 % banana peel powder

Proximate Analysis

Moisture, protein, fat and ash contents of the products were determined as per AOAC (1995) method.

Mineral Profile Analysis

Analysis of mineral profile viz, manganese (Mn), iron (Fe), zinc (Zn), copper (Cu) of chicken patties was done as per Horowitz (1965). Potassium (K) and phosphorus content content was estimated by using flame photometer and UV spectrophotometer respectively.

Physico-Chemical Analysis

The pH of chicken patties was evaluated as per Troutt *et al.* (1992) method. The emulsion stability was determined by the method of Baliga and Madaiah (1970). The cooking yield was calculated and expressed in percentage as per Murphy *et al.*, 1975. Total cholesterol and mineral content of chicken patties was determined as per the method of Zaltkis *et al.* (1953) and Horowitz (1965) respectively. Water activity of each sample was measured using a water activity meter (AquaLab 3 TE, Inc. Pullman, WA). Moisture and fat retention were determined according to equation presented by El-Magoli *et al.* (1996) and Murphy *et al.* (1975) respectively.

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Instrumental Colour Analysis

The colour parameters of the chicken patties were measured using Hunter colourimeter of Colour Tech PCM+ (Colour Tec Associates Inc. Clinton NJ, USA) at department of GPT, CIRG, Makdhoom. The coin shaped lance of instrument attached to software was directly put on the surface of functional chicken patties at randomly chosen six different points (Hunter and Harold, 1987). CIE *L**, *a** and *b** values were determined as indicators of lightness, redness and yellowness, respectively.

Sensory Evaluation

The sensory quality of samples was evaluated by using 8 point descriptive scale (Keeton *et al.*, 1983) where 8 denoted extremely desirable and 1 denoted extremely poor. A sensory panel (semi trained) of seven judges drawn from post-graduate students and faculty members of Veterinary College, DUVASU, Mathura were requested to evaluate the product for different quality attributes viz., General appearance, flavour, texture, juiciness, saltiness, mouth coating, meat flavour intensity and overall acceptability.

Statistical Analysis

The data obtained during the study were statistically analyzed on 'SPSS-16.0' software package as per standard methods of Snedecor and Cochran (1995). Data were subjected to one-way analysis of variance, homogeneity test and Duncan's Multiple Range Test (DMRT) for comparing the means to find the effects between samples. Duplicate samples replicated thrice (n=6) for each parameter, however sensory evaluation was performed by a panel of seven judges three times (n=21).

Results and Discussion

Physico-Chemical Properties

The physico-chemical properties of functional chicken patties incorporated with different fat replacers are presented in Table 2. The emulsion pH of C was significantly ($P<0.05$) higher than treatments. Among the treatments, LA1 had significantly ($P<0.05$) lower pH value than MP2, which might be due to highly acidic nature of citrus fruits as compared to other fruits. Emulsion stability of C was comparable to LA1, however significantly ($P<0.05$) decreased in MP2 and BP2, however cooking yield and moisture content of LA1 and MP2 were significantly ($P<0.05$) higher than C and BP2. This might be due to the addition of water and natural fat replacers in treatments to maintain the formulation during fat replacement. Eda *et al.* (2015) also observed better cooking yield, moisture retention, and fat retention for lemon fiber than carrot fiber. Product pH of C was significantly ($P<0.05$) higher than MP2 and BP2; however, pH value of was comparable with C and MP2, which might be due to addition of less amount (1%) of fat replacers in LA1 than other treatments.

Control had significantly ($P<0.05$) higher fat and cholesterol content, while significantly ($P<0.05$) lower fat retention and moisture retention values than treatments, but there was no significant difference between

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LA1, MP2 and BP2, which is oblivious due to replacement of 50% fat in treatments with fat and oil-holding fruit fibers. There was no significant difference in protein content, due to similar percentage of lean meat used in the formulation. The addition of fat replacers had significant (P<0.05) effect on ash content of product due to difference in the mineral contents of different fruits byproduct. Water activity of C and LA1 were significantly (P<0.05) higher than MP2, due to the difference in the water binding capacity of different fibres. Eda *et al.* (2015) demonstrated better technological in terms of cooking yield, moisture retention, and fat retention for lemon fiber than carrot fibre.

Table 2: Physico-chemical properties (Mean ± S.E.) of functional chicken patties in corporated with optimum level of different fat replacers

Parameter	C	LA1	MP2	BP2	Treatment mean
Emulsion pH	6.00^{a}±0.03	5.65^{c}±0.03	5.79^{b}±0.04	5.75^{bc}±0.04	5.80±0.03
Emulsion stability (%)	95.69^{a}±0.71	94.58^{ab}±0.60	93.96^{b}±0.42	93.42^{b}±0.41	94.41±0.31
Cooking yield (%)	88.51^{c}±0.49	91.31^{a}±0.27	90.85^{a}±0.26	89.79^{b}±0.31	90.11±0.27
Product pH	6.20^{a}±0.02	6.07^{ab}±0.02	5.98^{bc}±0.09	5.89^{c}±0.04	6.03±0.03
Moisture (%)	61.88^{c}±0.38	67.59^{a}±0.33	65.26^{a}±0.16	64.41^{b}±0.34	64.78±0.45
Fat (%)	10.18^{a}±0.16	4.75^{b}±0.12	4.89^{b}±0.18	4.76^{b}±0.23	6.15±0.49
Protein (%)	19.82±0.26	19.27±0.61	19.46±0.42	19.24±0.43	19.45±0.21
Ash (%)	2.62^{b}±0.11	2.64^{b}±0.10	2.77^{ab}±0.06	2.97^{a}±0.09	2.75±0.05
Cholesterol (mg/100mg)	81.45^{a}±0.34	77.99^{b}±1.41	76.90^{b}±1.77	76.81^{b}±0.72	78.28±0.64
Fat retention (%)	85.54^{b}±1.00	90.27^{a}±0.79	90.20^{a}±0.24	90.06^{a}±0.54	89.93±0.52
Water activity	0.98^{a}±0.00	0.99^{a}±0.00	0.96^{b}±0.00	0.97^{ab}±0.00	0.97±0.00
Moisture retention (%)	59.64^{b}±0.73	62.37^{a}±0.37	61.26^{a}±0.43	61.48^{a}±0.48	61.19±0.31

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

Mineral Profile Analysis

The mineral content of control and treatments was significantly (P<0.05) different except manganese content (Table 3). Iron, copper and zinc content of C was significantly (P<0.05) higher than treatments. Potassium content of MP2 and BP2 was significantly (P<0.05) higher than C and LA1. MP2 had significantly (P<0.05) higher phosphorus content than LA1 and BP2; however phosphorous content of LA1 was comparable with control. The variation in mineral content of product might be due to difference in mineral content of different fruit byproducts. Banana peel is rich source of micronutrient i.e. K, Ca and Mn, but contains negligible amount of Zn, Fe, Cu and P (Mohapatra *et al.*, 2010).

Table 3: Mineral profile analysis (Mean ± S.E.) of functional chicken patties incorporated with optimum level of different fat replacers

Mineral (mg/100mg)	C	LA1	MP2	BP2	Treatment mean
Manganese	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00
Iron	0.51^{a} ±0.00	0.14^{b}±0.00	0.13^{b}±0.01	0.14^{b}±0.00	0.23±0.03
Copper	0.69^{a}±0.00	0.44^{c}±0.01	0.58^{b}±0.00	0.57^{b}±0.00	0.57±0.01

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Zinc	0.67^{a}±0.03	0.44^{b}±0.04	0.43^{b}±0.01	0.31^{b}±0.08	0.46±0.03
Potassium	327.25^{b}±0.78	317.90^{b}±0.94	403.89^{a}±0.81	411.66^{a}±0.86	365.18±0.43
Phosphorus	70.56^{ab}±2.44	66.62^{bc}±1.16	73.71^{a}±1.45	65.22^{c}±1.25	69.03±1.04

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

Instrumental Colour Analysis

The color values of functional chicken patties incorporated with different natural fat replacers are presented in Table 4. Lightness (*L**) and yellowness (*b**) values of LA1 were significantly (P<0.05) higher than MP2 and BP2. Higher *L** and *b** values of LA1 might be due to whitish yellow colour of lemon albedo powder. There was no significant difference in redness (*a**) values between control and treatments. Eda *et al.* (2015) observed no difference in *a** value of carrot and lemon fiber treated beef hamburger. He also reported significantly (P<0.05) higher *L** value in cooked lemon fiber added low-fat beef hamburgers than carrot fiber. Fernandez-Ginés *et al.* (2004) also reported that incorporation of lemon albedo in sausages significantly (P<0.05) increased *L** and decreased *a**.

Table 4: Instrumental colour values (Mean ± S.E.) of functional chicken patties incorporated with optimum level of different fat replacers

Parameter	C	LA1	MP2	BP2	Treatment mean
Lightness *(L*)*	42.69^{ab}±1.74	47.29^{a}±2.43	38.25^{b}±0.74	34.20^{c}±0.30	40.60±1.25
Redness *(a*)*	7.85±0.82	7.59±0.80	8.75±0.27	7.92±0.90	8.03±0.35
Yellowness *(b*)*	15.53^{ab}±1.67	16.58^{a}±0.44	15.51^{b}±0.24	13.30^{c}±0.34	15.25±0.67

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

Sensory Evaluation

The mean sensory scores of functional chicken patties incorporated with different fat replacers are presented in Table 5. Colour and appearance scores of C and LA1 were significantly (P<0.05) higher than MP2 and BP2 due to dark colour of mango and banana peel powder, which provided comparatively undesirable colour to the product. C had (P<0.05) higher than flavour score than LA1, MP2 and BP2, however there was no significant difference between MP2 and BP2. Juiciness score of LA1 was significantly (P<0.05) higher than C, however scores of MP2 and BP2 were comparable to C and LA1. Higher juiciness scores of treatments than control might be due to addition of water to maintain the formulation as well as moisture retention capacity of fruits fibers used as fat replacers. There was no significant difference between control and treatments for saltiness. Texture, mouth coating, meat flavour intensity and overall acceptability scores of C and LA1 had no significant difference, but MP2 and BP2 had significantly (P<0.05) lower scores than C and LA1. Verma *et al.* (2015) reported highest acceptability for 1.0% Sweet potato powder and 9.0% chilled water added low fat pork patties. In present study, LA1 had significantly (P<0.05) higher sensory scores for than MP2 and BP2 except saltiness, however scores for most of sensory attributes did not differ significantly between C and LA1.

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Table 5: Sensory evaluation (Mean ± S.E.) of functional chicken patties incorporated with optimum level of different fat replacers

Attribute	C	LA1	MP2	BP2	Treatment mean
Colour and appearance	7.23^{a}±0.03	7.19^{a}±0.03	6.92^{b}±0.03	6.80^{c}±0.03	7.03±0.02
Flavour	7.18^{a}±0.02	7.04^{b}±0.02	6.91^{c}±0.02	6.84^{c}±0.03	6.99±0.01
Texture	7.21^{a}±0.03	7.14^{a}±0.02	7.05^{b}±0.03	7.06^{b}±0.03	7.11±0.01
Juiciness	7.00^{b}±0.03	7.10^{a}±0.03	7.01^{ab}±0.03	7.03^{ab}±0.02	7.03±0.01
Saltiness	7.12±0.03	7.09±0.03	7.11±0.02	7.09±0.02	7.10±0.01
Mouth coating	7.08^{a}±0.04	7.01^{a}±0.03	6.85^{b}±0.04	6.88^{b}±0.03	6.96±0.02
Meat flavour intensity	7.15^{a}±0.05	7.08^{a}±0.03	6.85^{b}±0.04	6.87^{b}±0.03	6.99±0.02
Overall acceptability	7.18^{a}±0.03	7.11^{a}±0.03	6.98^{b}±0.03	6.90^{b}±0.04	7.04±0.02

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

Conclusion

Functionality of meat products could be increased with use of different natural fat replacers. Addition of 1% lemon albedo powder as fat replacer with replacement of 50% added fat in formulation improves functionality of chicken patties without affecting quality.

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