



Original Research

Efficacy of Composite Fat Replacer Mixture of Sodium Alginate and Carrageenan for Development of Low Fat Pork Patties

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Abstract

Composite fat replacer mixture of sodium alginate (SA) and carrageenan (Crg) was optimised to develop Low-fat pork patties (LFPP). LFPP (0% added fat) were developed with three different combinations of SA and Crg percentage i.e. LFPP-1 (0.10/0.75), LFPP-2 (0.20/0.50) and LFPP-3 (0.30/0.25) and were compared with control pork patties (10% added fat) for compositional, processing and sensory characteristics. The moisture content of raw emulsion and cooked LFPP were significantly ($P < 0.05$) higher than control. The cooking yield, moisture and fat retention was measured highest for LFPP-3 and lowest for control product. Flavour scores were comparable in all products. Texture, juiciness and overall acceptability scores were measured highest for LFPP-2 and were comparable with control high-fat pork patties. LFPP (<10% total fat) with more than 56% lower calorie content and with improved cooking yield, textural and sensory attributes can be successfully developed by incorporating composite fat replacer of 0.2% sodium alginate and 0.50% carrageenan.

Key words: Fat Replacer, Low-Fat Pork Patties

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Introduction

The World Health Organization (WHO) has drawn up the following nutritional recommendations: fat should provide 15 to 30% of the calories in the diet, and out of this saturated fat should not provide more than 10% of calories, and cholesterol intake should be limited to 300 mg/day (Zhuang *et al.*, 2016). Emulsified meat products, diminishing fat without increasing water content results in a harder product (Cofrades *et al.*, 2008), while fat replacement with water increases exudative and cooking losses (Choi *et al.*, 2012) and also affects texture and juiciness of the product (Cierach *et al.*, 2009). Therefore the meat





industry faces a new challenge: how to find a substitute for fat replacement to produce a low-fat healthy meat product having acceptable water- and fat-binding capacities, textual properties, processing properties like cooking yield, emulsion stability & sensory properties texture, flavor and overall acceptability.

In order to reduce these problems different strategies had been applied such as: add proteins (soy proteins, whey protein concentrate, gluten, sodium caseinate), gums (xanthan, locust bean gum, microcellulose, pectins, konjac), and/or sodium polyphosphate in different combinations (Ayadi *et al.*, 2009; Brewer, 2012; Hsu & Sun, 2006; Jiménez Colmenero *et al.*, 2012; Muchenje *et al.*, 2009; Youssef & Barbut, 2011).

Hydrocolloids or gums are considered to be widely acceptable fat replacer because they regulate viscosity, form gels, stabilize emulsions inhibit syneresis and contribute <1 cal/g on dry weight basis (Kumar *et al.*, 2004). Sodium caseinate and carrageenan (kappa and iota) improves the texture of low-fat meat products, as these fractions can form complexes with water and proteins (Kumar *et al.*, 2007; Cierach and Szacilo, 2003). Chatli *et al.*, 2017 evaluated efficacy of sodium alginate as a fat replacer in low-fat buffalo mozzarella cheese revealing that increase in the level of sodium alginate increased the percent yield of treated low-fat cheese. Kumar and Sahoo (2006) developed low fat chevon loaves using different levels of sodium alginate as fat replacer and increase in texture and overall acceptability compared to other sodium alginate levels, while Suman and Sharma (2003) developed low fat buffalo meat patties with 5.95, 7.87 and 9.57 percent fat levels using carrageenan and sodium alginate without affecting sensory quality.

Among many hydrocolloids investigated sodium alginate and carrageenan turned out to be especially effective in the production of low-fat meat products. So present study was carried out to select the optimum level of combination of sodium alginate (SA) and carrageenan (Crg) powder in the formulation of low-fat ground pork patties on the basis of compositional, processing and sensory qualities. The selected formulation was compared to a high-fat control for physico-chemical and sensory properties.

Materials and Methods

Market age crossbred castrated hogs (n=3) weighing 60-70 kg of crossbred (Landrace x Local) were procured from instructional livestock farm, GADVASU, Ludhiana and humanely slaughtered at the Divisional Experimental Abattoir of GADVASU, Ludhiana considering animal welfare aspects. All skin, subcutaneous fat, bone, seam fat and necessary connective tissue were manually removed. Lean trimmings and back-fat free from skin were stored separately at $-18 \pm 2^{\circ}\text{C}$ in low density polyethylene (LDPE) packs till use and after partial thawing at 5°C for 12hr were used for the preparation of ground pork patties. The spice mixture, condiments and other additives were purchased from the local market (onion, garlic, ginger; 3:1:1). The lean meat and back fat were minced separately through 6 mm and 4 mm plates in an Electrolux meat mincer (Model 9512).



Preparation of Patties

Pork patties were prepared using the formulation as per Table 1. Emulsions were prepared in four groups for control (CON) and treatments with varying combinations of SA and Crg as fat replacer as LFPP - 1(0.10/0.75%), LFPP-2 (0.20/0.50%) and LFPP-3(0.30/0.25%), respectively. The deboned frozen pork was cut into small chunks and minced twice in a meat mincer (Mado Eskimo Mew-714, Mado, Germany) through 6 mm and 4 mm plates. Then, emulsion was prepared in a bowl chopper (Model: TC11, Scharfen, Germany). The emulsions obtained were moulded in a mould of dimensions (75×15 mm). The patties were cooked in pre heated hot air oven at 180±5°C for 25 min. with intermittent turning upside down to have better colour and appearance to attain the internal core temperature of more than 72°C. The cooked patties were tempered to room temperature and samples were collected for various quality analysis.

Proximate Analysis

Moisture (oven drying), protein (Kjeldahl distillation), fat (Soxhlet method) and ash (muffle furnace) content of both control and low-fat pork patties were determined by using standard procedure described by AOAC (2000). Estimates of total calories content were calculated on the basis of 100 g portion using Atwater values for fat (9 kcal/g), protein (4.02 kcal/g) and carbohydrate (4 kcal/g). An analysis of the percentage of carbohydrate in the samples was determined by numerically formulae (carbohydrate = 100 – moisture + protien + fat + ash).

Physico-chemical Analysis

Emulsion stability was determined using the method described by Townsend *et al.* (1968) with light modifications. About 25 g emulsion samples were placed in polyethylene bags, sealed and heated at 80°C in a thermostatically controlled water bath for 20 min. After draining out the exudate, the cooked mass was cooled, weighed and the yield was expressed as percent emulsion stability. Cooking yield was determined by measuring the difference in the sample weight before and after cooking (Murphy *et al.*, 1975).

$$\text{Cooking Yield (\%)} = \frac{\text{Weight of cooked pork patties} \times 100}{\text{Weight of uncooked pork patties}}$$

The dimensional parameters of the pork patties were measured by vernier calliper at three different places. The percent gain in height and decrease in diameter percent were determined (Kumar and Sharma, 2004).

Reduction in pork patty diameter (%) = [(uncooked pork patty diameter – cooked pork patty diameter) / uncooked pork patty diameter] ×100

Gain in height (%) = [(cooked pork patty height– uncooked pork patty height)/uncooked pork patty height] ×100



The moisture and fat retention value represents the amount of moisture or fat retained in the cooked product per 100 g of raw sample (Kumar and Sharma, 2004).

Moisture retention (%) = [(% yield) × (% moisture in pork patty)]/100

Fat retention (%) = {[(cooked wt.) × (% fat in cooked pork patty)] / [(uncooked wt.) × (% fat in uncooked pork patty)]} × 100

The pH of pork patties was measured as per the procedure of Trout *et al.* (1992) using combined glass electrode of Elico pH meter (Model LI 127, Elico Limited Hyderabad, India). Water activity was determined using potable digital water activity meter (Rotronix HYGRO Palm AW1 Set, Rotronix Instrument Limited., West Sussex, UK. Briefly, finely ground pork patties were filled up (80%) in a moisture free sample cup. The sample cup was placed into the sample holder, and then sensor was placed on it for five min for a_w value. Duplicate reading was performed for each sample.

Colour Profile Analysis

Colour profile was measured using CR-400, Konica Minolta, chromameter (Japan) 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. Then the above colour parameters were selected. The instrument was directly put on the surface of pork patties at different points and readily was taken in triplicate at different for each sample.

Texture Profile Analysis

Texture profile analysis of pork patties were performed using a Texture Analyser (TMS-PRO, Food Technology Corporation, VA, 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 of 5 mm/s, test speed of 1 mm/s, post-test speed of 1 mm/s, distance 10 mm and exposure time 3s. Texture profile parameters such as hardness, adhesiveness, cohesiveness, springiness chewiness and gumminess were estimated using software (TMS-Pro, USA).

Sensory Evaluation

A seven member trained panel comprising of scientists and postgraduate students of the LPT department evaluated the samples for the attributes viz. appearance and colour, flavour, tenderness, juiciness and overall acceptability using 8 point descriptive scale (Keeton, 1983), where 8 = extremely desirable and 1 = extremely undesirable. Three sittings (n = 21) were conducted for each replicate. The panelists carried out



evaluation in a room free of noise and odours and suitably illuminated with natural light. Coded samples at a temperature of $37^{\circ}\pm 3^{\circ}\text{C}$ were presented 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 was subjected to statistical analysis (Snedecor and Cochran, 1989) for one way analysis of variance using completely randomized design and Duncan's multiple range test to compare the means by using SPSS-20 (SPSS Inc., Chicago, IL, USA). Duplicate samples were drawn for processing parameter and the experiment was repeated thrice ($n = 6$), while for instrumental texture profile & color profile analysis triplicate samples were drawn and the experiment was repeated thrice ($N=9$). Sensory evaluation was performed by a panel of seven member judges for three times, so total observations being 21 ($n = 21$). The statistical significance was expressed at ($P<0.05$).

Results and Discussion

Physico-chemical analyses of low-fat pork patties incorporated with varying levels of composite fat replacer of carrageenan and sodium alginate are presented in Table 1.

Table 1: Formulation of low-fat pork patties

Ingredients (% w/w)	CON	LFPP-1	LFPP-2	LFPP-3
Pork meat	70.2	79.35	79.5	79.65
Added fat	10	0	0	0
Refined wheat flour	3	3	3	3
Chilled water	10	10	10	10
Condiments	2	2	2	2
Spices mix.	3	3	3	3
Salt	1.5	1.5	1.5	1.5
Sodium tetra pyro-phosphate	0.3	0.3	0.3	0.3
Sodium alginate	---	0.1	0.2	0.3
Carageenan	---	0.75	0.5	0.25

Additive Sodium nitrite 100 ppm in all treatments and control; CON: Control; LFPP = low-fat pork patties

The pH value of treated emulsion was comparable and was significantly ($P<0.05$) higher than control (Table 2). It can be attributed to innate pH value of added composite mixture and water absorption ability of the mixture. On comparison, it was observed that the pH of cooking patties was significantly ($P<0.05$) higher than the emulsion pH, irrespective of addition or non-addition and quantity of added composite fat replacer in the formulation mixture. This is attributable to the concentration of food components due to moisture loss, denaturation and deamination of proteins with heating in the cooked product. The findings are in accordance with Singh *et al.* (2010) and Kumar *et al.* (2007). The percent moisture and protein, and moisture to protein ratio were significantly ($P<0.05$) higher, whereas fat per cent was significantly ($P<0.05$)



lower in treated product than high-fat control. It might be due to the difference in formulation especially added fat in the control and treated emulsion. Perusal of (Table 2) revealed that fat content of low-fat patties varied 7.24-7.52%, well below the limits (<10%) prescribed for low-fat meat products (Zhuang *et al.*, 2016). Emulsion stability and cooking yield was significantly ($P<0.05$) higher in low-fat pork patties than high-fat control product, due to water holding capacity of both carrageenan and sodium alginate (Kumar *et al.*, 2007). These findings are in correspondence with the results of Yadav & Sharma (2005) and Kumar and Sahoo (2006). The cooking losses are in accordance with the cooking yield and are lower in treated products than control. This might be due the formation of the stable protein-gel lattice structure that prevents the loss of the water and fat from the cooked patties (Goll *et al.*, 1992). These results are in conformity with our results of moisture and fat retention. Similar findings were reported by the Kumar *et al.* (2007) in low-fat ground pork patties incorporated with different levels 0.1, 0.2 and 0.3 percent sodium alginate.

Table 2: Effect of composite fat replacer mixture of sodium alginate and carrageenan on physico-chemical properties of pork emulsion and cooked pork patties

Parameters	CON	LFPP-1	LFPP-2	LFPP-3
Pork Emulsion Characteristics				
pH	5.68±0.01 ^a	5.93±0.02 ^b	5.93±0.05 ^b	5.87±0.01 ^b
Moisture (%)	64.57±0.17 ^a	73.42±0.24 ^b	74.78±0.11 ^b	74.71±0.18 ^b
Protein (%)	15.26±0.17 ^a	17.36±0.11 ^b	17.71±0.17 ^b	17.39±0.12 ^b
Fat (%)	14.25±0.14 ^b	6.34±0.21 ^a	6.74±0.11 ^a	6.78±0.37 ^a
Moisture: Protein ratio	4.23±0.06 ^a	4.28±0.07 ^b	4.27±0.05 ^b	4.29±0.01 ^b
Cooked pork patties Characteristics				
pH	6.08±0.05 ^a	6.16±0.06 ^b	6.18±0.04 ^b	6.19±0.05 ^b
Moisture (%)	56.79±0.15 ^a	67.29±0.17 ^b	68.18±0.13 ^b	67.28±0.11 ^c
Fat (%)	15.26±0.13 ^b	7.24±0.13 ^a	7.36±0.18 ^a	7.52±0.17 ^a
Protein (%)	18.29±0.11 ^a	21.40±0.09 ^b	21.27±0.05 ^b	21.31±0.08 ^b
Moisture : Protein ratio	3.10±0.05 ^a	3.14±0.11 ^b	3.19±0.17 ^b	3.15±0.19 ^b
Ash (%)	3.01±0.02 ^a	3.10±0.01 ^b	3.14±0.04 ^b	3.14±0.02 ^b
Water activity (a _w)	0.78±0.02 ^a	0.82±0.03 ^b	0.83±0.05 ^b	0.83±0.05 ^b

N=6; *Mean ±S.E. with different superscripts row-wise (a-d) differ significantly ($P<0.05$)

In general, as discussed above the percent moisture content was higher in low-fat products than control attributed to moisture retention capacity of added fat replacers. This has lead to higher moisture protein ratio. However, in all the cases it was lower than 4.0, threshold value of deformed texture in case of cooked meat products. The lower fat retention in control product might be due to fat leakage with melting of fat globules on penetration of high heat, whereas the molten fat was trapped in dense matrix of cross-linked polymeric macro molecular network of carrageenan and sodium alginate (Herreroa *et al.*, 2014). Total calories content decreased 56% to 58% in developed low-fat pork products. This is because of no added fat in the formulation Total fat content also reduced more than 50% in the treated products. Percent ash content increased ($P<0.05$) with the addition of SA and Crg attributed to minerals contributed by them.

Table 3: Effect of composite fat replacer mixture of sodium alginate and carrageenan on processing parameters of pork patties

Parameters	CON	LFPP-1	LFPP-2	LFPP-3
Gain in height (%)	24.22±0.09 ^a	32.08±0.11 ^b	34.09±0.14 ^c	35.3±0.11 ^d
Decrease in diameter (%)	22.94±0.12 ^a	18.76±0.13 ^b	17.76±0.14 ^b	16.21±0.14 ^c
Shrinkage (%)	23.28±0.32 ^a	19.01±0.36 ^b	17.40±0.37 ^b	17.38±0.47 ^c
Emulsion Stability (%)	83.22±0.23 ^a	86.41±0.54 ^b	87.65±0.37 ^c	87.51±0.61 ^d
Cooking Yield (%)	84.55±0.31 ^a	88.48±0.24 ^b	88.65±0.54 ^c	88.34±0.47 ^c
Cooking loss (%)	15.45±0.57 ^b	11.52±0.37 ^a	11.35±0.36 ^a	11.66±0.47 ^a
Moisture retention (%)	48.01±0.31 ^a	59.53±0.38 ^b	60.17±0.42 ^b	59.43±0.47 ^b
Calories content	213.16±0.45 ^b	155.06±0.31 ^a	152.34±0.41 ^a	156.74±0.21 ^a
Fat retention (%)	71.22±0.14 ^a	73.07±0.16 ^b	78.53±0.51 ^c	78.51±0.57 ^c

N=6, Mean ±S.E. with different superscripts row-wise (a-d) differ significantly ($P<0.05$)

The dimensional parameters viz. decrease in diameter, increase in height and shrinkage percent ($P<0.05$) varied with the level of incorporation of fat replacer. The percent increase in height was significantly higher in LFPP-2 and LFPP-3 than control. The corresponding shrinkage percentage was significantly ($P<0.05$) lower in LFPP-2 & LFPP-3 than LFPP-1. Shrinkage was significantly ($P<0.05$) higher in control than all the treated products. In general, the dimensional parameters were better maintained in the low-fat pork patties than control attributed to gelling properties of SA and Crg. The improved dimensional statistics in LFPP-2 & LFPP-3 could be due to the formation of desirable gel strength achieved through appropriate ratio of SA and Crg. Similar results were reported by Nisar *et al.* (2009) in low-fat buffalo meat patties and Berry (1997) in low-fat beef patties.

Fat retention was significantly higher in LFPP-2 and LFPP-3 than LFPP- 1 and control. It can be correlated with network formed by appropriate ratio of sodium alginate and carrageenan in which fat globules are entrapped readily to lower leaching out of fat during cooking of the product. Similar findings were reported by the Egbert *et al.* (1991) and Binger-George and Berry (2000) in beef patties.

Instrumental Colour Profiles

The colour attributes of cooked meat products directed mainly by the pigmentation of the meat with which they are made, and by the variations of pigment conversion rates occurring on cooking. Lightness was significantly ($P<0.05$) higher in low-fat products than control and it was recorded highest for LFPP-2 & LFPP-3. Redness (a^*) increased in treated product, this result was also supported by the sensory attributes that indicates increased in the appearance and overall acceptability of the treated patties than control. Dreeling *et al.* (2002) and Jeong *et al.* (2007) also found that lower-fat patties were slightly darker than those containing more fat, addition of composite fat replacer of SA and Crg lead to increase in product, yellowness (b^*). Yellowness was recorded significantly ($P<0.05$) higher in control than treated products, whereas a non-significant increase in yellowness (b^*) was observed in low-fat pork products. Modi *et al.*



(2009) observed no difference in 'a' and 'b' values ($P < 0.05$) among the different levels of carrageenan used in formulation of meat kofta.

Table 4: Effect of composite fat replacer mixture of sodium alginate and carrageenan on instrumental colour profile of pork patties

Parameters	CON	LFPP-1	LFPP-2	LFPP-3
Lightness (L^*)	53.34±0.05 ^a	55.54±0.04 ^b	56.39±0.06 ^b	56.68±0.05 ^b
Redness (a^*)	11.41±0.04 ^a	12.45±0.01 ^b	13.15±0.02 ^b	13.64±0.04 ^b
Yellowness (b^*)	14.10±0.02 ^a	19.38±0.04 ^b	21.31±0.01 ^b	21.33±0.09 ^b

$N=9$, Mean $\pm$ S.E. with different superscripts row-wise (a-d) differ significantly ($P < 0.05$)

Instrumental Texture Profile Analysis

Significant ($P < 0.05$) increase in hardness value of low-fat pork patties was observed with incorporation of different levels of SA and Crg as compared to high fat control. Among the treated products the hardness value was increased gradually however lowest hardness value was recorded for LFPP-1. Similar observations were recorded by Bloukas *et al.* (1997) who reported low-fat comminuted products to be tougher than higher fat ones. Jeon *et al.* (2004) also reported comparable hardness value in low-fat chicken patties incorporated with sodium alginate to high-fat control (20% added fat).

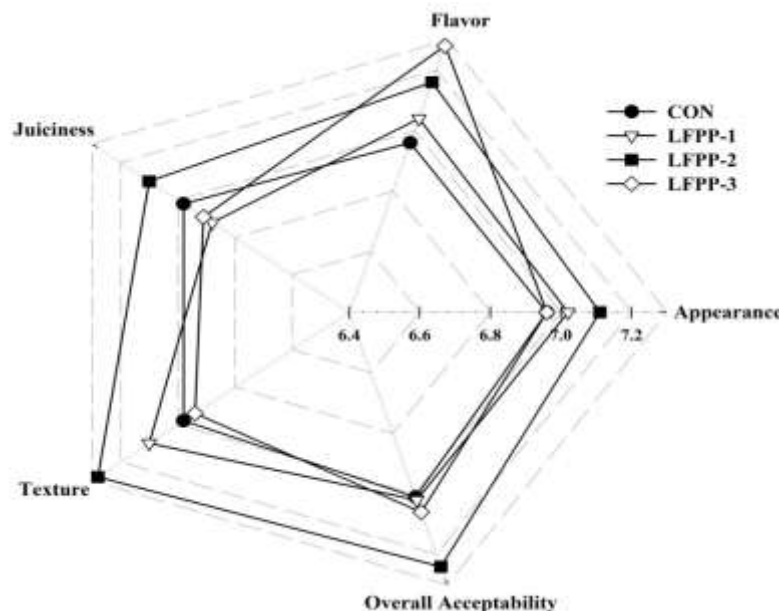
Table 5: Effect of composite fat replacer mixture of sodium alginate and carrageenan on instrumental texture profile of pork patties

Parameter	CON	LFPP-1	LFPP-2	LFPP-3
Hardness (N/cm ²)	11.1±0.07 ^a	14.4±0.05 ^b	14.6±0.04 ^b	14.9±0.02 ^b
Springiness (cm)	15.36±0.11 ^a	16.64±0.17 ^b	18.27±0.14 ^c	19.07±0.13 ^d
Stringiness	18.42±0.17 ^a	20.85±0.15 ^b	21.10±0.12 ^b	22.93±0.14 ^b
Cohesiveness (ratio)	0.74±0.05 ^a	0.88±0.07 ^b	0.92±0.05 ^b	0.93±0.05 ^b
Chewiness (N/cm)	103.18±0.10 ^a	115.07±0.14 ^b	114.47±0.14 ^b	116.51±0.11 ^b
Gumminess (N/cm ²)	14.75±0.21 ^a	12.62±0.27 ^b	11.72±0.11 ^b	11.73±0.28 ^b
Resilience(N)	0.94±0.05 ^a	0.82±0.01 ^b	0.81±0.02 ^b	0.79±0.04 ^b

$N=9$, Mean $\pm$ S.E. with different superscripts row-wise (a-d) differ significantly ($P < 0.05$)

Cohesiveness increases significantly ($P < 0.05$) in low fat product group as compared to control. Pietrasik & Duda (2000) also reported an increase in cohesiveness of low-fat comminuted scalded sausages at high levels of incorporation (3%) of a soya protein + carrageenan combination (PreparateTN). Chewiness and springiness improved in the low-fat product because of the gel-like nature of SA and Crg (Kumar and Sharma, 2004), which imparts better elasticity to the texture of product. Addition of SA and Crg in the low-fat ground pork patties exhibit lower gumminess values as compared to control which showed inverse trend with springiness values. Jeon *et al.* (2004) and Mittal & Barbut (1994) reported similar observations as positive influence of incorporation of carrageenan on product hardness, springiness and chewiness of low-fat frankfurters. The textural attribute of low-fat pork patties are directed by the combined effect of added

water and SA and Crg forming a gel which consisting of cross-linked polymeric molecules to form a three-dimensional macro molecular network containing a large fraction of water within their structure which displays mechanical rigidity (Herreroa *et al.*, 2014).



Means are scores given by sensory panelists on an 8-point Hedonic scale where 1: extremely poor and 8: extremely desirable, N=21

Fig. 1: Effect of composite fat replacer mixture of sodium alginate and carrageenan on sensory quality parameters of pork patties

Sensory Evaluation

Perusal of Fig.1 of the sensory attributes of pork patties showed that fat content cooking significantly ($P < 0.05$) influenced the appearance parameters. The colour and appearance score of the LFPP-2 was found to be the highest amongst treatments and control. The improved colour and appearance score can be correlated with the results of instrumental colour profile. The flavour scores were comparable with control, whereas highest in LFPP-3. The juiciness scores were highest for the LFPP-2 amongst treated low-fat pork patties. This could be due to the stable protein-gel lattice structure that prevents the loss of the water and fat from the cooked patties. Yadav and Sharma (2005); Kumar and Sahoo (2006); Kumar and Sharma (2004) also showed increase in juiciness with addition of SA and Crg in low-fat chevon rolls, low fat chevon loaves, low-fat ground pork patties products respectively. The sensory panellists awarded highest textural score to LFPP-2 amongst the treatment and control. The texture score LFPP-1 and LFPP-2, were statistically comparable however the numerical value of LFPP-2 was highest and LFPP-3 was lowest among the all the products. The perceptions of sensory panellists are in accordance with the results of instrumental texture profile. It might be due to appropriate proportion of SA and Crg leading to formation of gel of



desirable strength and improved texture of the products. Higher texture scores of low-fat ground pork patties incorporated with combination group could be due to comparatively better texture modifying and stabilizing action of carrageenan and sodium alginate (Kumar *et al.*, 2004). The overall acceptability scores were highest in LFPP-2 amongst treatment, whereas LFPP-1 & LFPP-3 were comparable to control. The low-fat pork patties incorporated with composite fat replacer of SA (0.20%) and Crg (0.50%) was rated highest for overall acceptability by the sensory panellists.

Conclusion

The addition of composite fat replacer of sodium alginate and carrageenan improved the water holding capacity and textural properties of LFPP. The dimensional parameters such as gain in height, decrease in diameter and shrinkage were better maintained in low-fat pork patties. The moisture, fat retention and cooking yield were improved in low-fat pork products; however the sensory panellists rated LFPP-2 best amongst all the products. Low-fat pork patties developed with no added fat and composite fat replacer mixture of SA (0.20%) and Crg (0.50%) has highest cooking yield, improved textural and colour characteristics, and better overall acceptability than high fat control is recommended to meat industry for its commercial production for the benefit of health consumers.

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