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**Research Article**

# EFFECT OF FAT REPLACERS ON THE PROXIMATE COMPOSITION AND PHYSICO-CHEMICAL QUALITY OF LOW FAT CHEVON ROLLS

SANJAY YADAV[1] and D. P. SHARMA[2]
Department of Animal Products Technology, College of Animal Sciences
CCS Haryana Agricultural University, Hisar-125 004

## ABSTRACT

An investigation was carried out to study the proximate composition and physico-chemical quality of low fat chevon rolls developed by using whey protein concentrate (4% level), guar gum (0.5 % level) and starch (4% level) as fat replacers. Levels were selected on the basis of an earlier study carried out by the same authors. Moisture content of raw emulsions decreased on addition of fat replacers. Cooking resulted in a decrease in moisture and increase in protein content. Starch (4%) was most effective in increasing water holding capacity whereas salt soluble proteins were highest in case of chevon rolls containing 4% whey protein concentrate (WPC). Highest emulsion stability was observed in emulsion with guar gum at 0.5% level followed by starch and WPC at 4% levels each. Chevon meat rolls with 4% starch showed minimum cooking loss. Use of fat replacers reduced the shear press values of chevon meat rolls.

**Key words:** Fat replacers, chevon, physico-chemical properties, proximate composition

Fat replacers are substances used to replace fat in a food system. A number of non meat ingredients both of animal and plant origin such as whey protein concentrate (WPC), gums, starches, soy protein isolates, etc. have been used as fat replacers for production of low fat meat products. WPC, a by product of cheese manufacture, is a mixture of non-casein milk proteins, which provides an edible source of protein. Gums are carbohydrate based substances in nature and the one's commonly used in meat products are carrageenan, alginate and guar gum. Carrageenan is added to meat products to enhance water-holding capacity and to decrease cooking losses (Hughes *et al.*, 1997). Starch is another carbohydrate based fat replacer and is generally modified before use by acid or enzymatic hydrolysis and cross-linking or substitution. It works well in high moisture systems such as low fat spreads and meat emulsions by binding water and reducing rubberiness (Giese, 1996). The aim of present investigation was to study the nutritional and physico-chemical quality of chevon rolls prepared by using WPC, guar gum and starch as fat replacers.

## MATERIALS AND METHODS

About one year old healthy goats of Beetal breed, reared under identical feed and managemental conditions, obtained from the Animal Farm, College of Animal Sciences, CCS HAU, Hisar, were slaughtered and dressed as per the standard procedure. Meat obtained from leg portion was washed and packed in polythene bags and stored in deep freezer at $-18^0$ C for 18-24 h before further use. Pork back fat was obtained from local market and stored in deep freezer. The fat replacers used for the study were WPC (protein - 70%) of Mahaan Proteins Ltd., guar gum (Galactomannon - 83%) of Hindustan Gums and Chemical Ltd. and starch (Corn flour) of Weikfield Pvt. Ltd.

Meat rolls were prepared by using WPC (4%), guar gum (0.5%), starch (4%) and pork fat (10%) individually. Control did not contain added fat or fat replacers. Levels were selected on the basis of earlier study (Yadav and Sharma, 2005). Deboned frozen meat was minced in an

[1] M.V.Sc. student
[2] Corresponding author

electrical mincer. Additives and spices (sodium chloride -2%, sodium tripolyphosphate -0.25%, sodium nitrite -100 ppm, spice mix -2%, chilled water -10%) were added in control and in all the treatments, blended manually with the minced meat initially and then in a mixer for 30 seconds. Pork back fat was minced separately. Then the fat and fat replacers (mixed with water) as per individual treatments were added and all the ingredients were further mixed in the mixer for 2 minutes. The batter stuffed into 250 ml autoclavable beaker and covered with aluminium foil was cooked for 30 minutes at low flame. The product after removal from beakers was packed in polythene bags.

Proximate composition was determined by following the standard methods of AOAC (1995). Method of Knipe *et al.* (1985) for estimation of salt soluble proteins, press technique used by Whiting and Jenkins (1981) for measuring water holding capacity, method of Trout *et al.* (1992) for measuring pH and method of Saffle *et al.* (1967) for measuring emulsion stability were followed. The shear press value of meat samples was determined by using Warner Bratzler shear Press. Cooking yield and cooking loss were calculated by weighing the raw emulsion and cooked product. Data obtained were subjected to statistical analysis using a suitable statistical design according to Snedecor and Cochran (1980).

## RESULTS AND DISCUSSION

Control raw emulsion had a moisture content of 72.13% which decreased significantly to 64.95% when 10% fat was added in the meat rolls (Table 1). Addition of WPC and starch at 4% levels each also reduced the moisture content of raw emulsions. This reduction can be attributed to the quantitative replacement of meat, which is a high moisture product, with low moisture fat, WPC and starch. Hughes *et al.* (1998) also observed that addition of WPC and tapioca starch in frankfurters significantly reduced the moisture content. The highest protein content of 21.02% was observed in emulsion with 4% WPC which can be attributed to the concentrated protein content (70%) of WPC. Results are in accordance with that of Hughes *et al.* (1998) who also observed a significant increase in protein content of raw emulsions due to addition of concentrated protein sources like WPC. The lowest protein content (16.99%) was recorded in emulsions with 4% starch, which was due to the replacement of meat proteins by starch. There was no difference in the fat content of emulsions among control, WPC, guar gum and starch containing treatments. Ash content of the emulsion having 10% fat was the lowest (2.65%) among the treatments and control.

Addition of WPC and starch did not significantly alter the moisture content of cooked

**Table 1**
**Effect of different fat replacers on proximate composition of raw emulsions and cooked chevon rolls (n=6, mean ± S.D.)**

| Treatments | Raw emulsion | | | | Chevon rolls | | | |
|---|---|---|---|---|---|---|---|---|
| | Moisture (%) | Protein (%) | Fat (%) | Ash (%) | Moisture (%) | Protein (%) | Fat (%) | Ash (%) |
| Control | 72.13$^{a}$ ±0.95 | 18.01$^{b}$ ±0.39 | 4.32$^{b}$ ±1.31 | 2.87$^{a}$ ±0.13 | 69.97$^{a}$ ±1.29 | 19.90$^{c}$ ±0.59 | 4.08$^{b}$ ±0.62 | 2.91 ±0.59 |
| Fat 10% | 64.95$^{c}$ ±0.73 | 17.52$^{bc}$ ±0.46 | 11.40$^{a}$ ±0.45 | 2.65$^{b}$ ±0.20 | 63.68$^{c}$ ±0.57 | 20.02$^{c}$ ±0.80 | 11.60$^{a}$ ±0.75 | 2.88 ±0.16 |
| WPC 4% | 70.25$^{b}$ ±1.09 | 21.02$^{a}$ ±0.48 | 4.19$^{b}$ ±0.48 | 2.73$^{ab}$ ±0.17 | 69.19$^{a}$ ±0.93 | 22.42$^{a}$ ±1.08 | 4.05$^{b}$ ±0.61 | 2.83 ±0.41 |
| Guar gum 0.5% | 71.98$^{a}$ ±0.69 | 17.85$^{b}$ ±0.36 | 4.55$^{b}$ ±0.11 | 2.84$^{ab}$ ±0.06 | 67.52$^{b}$ ±0.80 | 21.04$^{b}$ ±0.58 | 4.48$^{b}$ ±0.17 | 2.97 ±0.24 |
| Starch 4% | 70.63$^{b}$ ±0.43 | 16.99$^{c}$ ±0.67 | 4.16$^{b}$ ±0.21 | 2.69$^{ab}$ ±0.30 | 70.01$^{a}$ ±1.15 | 18.66$^{d}$ ±0.86 | 4.69$^{b}$ ±0.44 | 2.94 ±0.22 |

Means with different lower case superscripts in a column differ significantly ($P \leq 0.05$)
WPC – Whey protein concentrate

chevon rolls as compared to control. Results are in accordance with that of Prabhu and Sebranek (1997) who observed no difference in moisture content in cooked hams on addition of modified corn starch. The moisture content of chevon rolls with guar gum was significantly lower than WPC and starch treatments. Addition of WPC resulted in highest protein content after cooking among all the treatments tried. Chevon rolls with 10% fat recorded the highest (11.60%) fat content after cooking. No significant difference in fat and ash content was noted in WPC, guar gum and starch treatments from control.

Per cent loose water (WHC) was 9.97% in the control emulsion (Table-2). Guar gum resulted in higher per cent loose water (10.03%) than WPC and starch emulsions. The lowest per cent loose water (8.27%) was recorded in emulsion added with starch. A significant increase in WHC in frankfurters has been reported by Hughes *et al.* (1997) on addition of oat fibre. Salt soluble proteins (SSP) decreased quantitatively in emulsion with 10% fat. Significantly higher SSP were observed in emulsion with WPC and guar gum than control. The pH of emulsion containing starch was significantly lower than WPC and guar gum. Per cent expressible fluid representing emulsion stability was the lowest in guar gum followed by WPC and starch treatments. WPC has been observed to provide stability through total entrapment of fat within the gel network (Rao *et al.*, 1999). Carrageenan and tapioca starch have also been reported to increase the emulsion stability of meat products (Bater *et al.*, 1992, Hughes *et al.*, 1998).

Addition of WPC significantly improved the cooking yield. The proteins present in WPC have been reported to reduce the cooking loss (Hughes *et al.*, 1998). It is believed that whey proteins are adsorbed at the fat/water interface where they unfold, thus stabilizing the globules within food matrix (Huffman, 1996). Guar gum meat rolls showed the maximum cooking loss. Hydrocolloid gelling agents like carrageenan are believed to enhance water holding capacity and decrease cooking loss (Hughes *et al.*, 1997) due to their thermal reversible gelatin properties (Bater *et al.*, 1992). In this study, guar gum did not show this effect. Probably the functionality of guar gum in meat system at high temperature of steaming is different and warrants further study. The highest cooking yield (95.47%) was observed in the chevon meat rolls added with 4% starch. The result of the study corroborates with those of Lyons *et al.* (1999) and Prabhu and Sebranek (1997) who used tapioca starch and modified corn starch, and reported increase

**Table 2**

**Effect of different fat replacers on physico-chemical parameters of raw emulsions and cooked chevon rolls (n=6, mean ± S.D.)**

| Treatments | Raw Emulsion | | | | Cooked rolls | | | |
|---|---|---|---|---|---|---|---|---|
| | WHC (% loose water) | SSP (%) | pH | Emulsion stability (n=3) (% TEF) | Cooking loss (n=3) (%) | Cooking yield (n=3) (%) | Shear press value (kg/cm³) | pH |
| Control | 9.97[b] ±1.42 | 7.00[c] ±0.35 | 6.09[ab] ±0.05 | 14.81[a] ±0.64 | 8.93[b] ±1.01 | 91.07[b] ±1.01 | 0.55[a] ±0.05 | 6.21[b] ±0.02 |
| Fat 10% | 13.28[a] ±1.75 | 6.49[d] ±0.51 | 6.11[ab] ±0.04 | 14.41[a] ±1.28 | 7.40[b] ±0.40 | 92.60[b] ±0.40 | 0.27[c] ±0.01 | 6.22[b] ±0.06 |
| WPC 4% | 9.55[b] ±0.04 | 9.53[a] ±1.32 | 6.12[a] ±0.48 | 3.70[b] ±0.04 | 6.27[c] ±1.70 | 93.73[a] ±0.83 | 0.35[b] ±0.83 | 6.28[a] ±0.04 |
| Guar gum 0.5% | 10.03[b] ±1.73 | 7.59[b] ±0.30 | 6.12[a] ±0.02 | 0.74[c] ±0.64 | 11.20[a] ±1.06 | 88.80[c] ±1.06 | 0.17[d] ±0.03 | 6.23[b] ±0.03 |
| Starch 4% | 8.27[b] ±1.27 | 6.72[cd] ±0.40 | 6.07[b] ±0.03 | 3.70[b] ±1.28 | 4.53[c] ±1.40 | 95.47[a] ±1.40 | 0.16[d] ±0.02 | 6.20[b] ±0.02 |

Means with different lower case superscripts in a column differ significantly ($P \leq 0.05$)

WPC – whey protein concentrate, SSP – salt soluble proteins, TEF – total expressible fluid in the cooking yield of meat products. Shear press value significantly decreased on addition of 10% fat. Beneficial effect of fat on shear press values in comminuted meat products has earlier been reported by Keeton (1994). All the three fat replacers significantly reduced the shear press values of chevon rolls. Guar gum and starch containing meat rolls exhibited minimum shear press values. Reduction in shear press value by addition of WPC, carrageenan, alginate and tapioca starch has been reported earlier (Lyons *et al.*, 1999, Lin and Keeton, 1998). On cooking, there was an increase in the pH of control and treated meat rolls as compared to raw emulsions. Babu *et al.* (1994) suggested that increase in the pH of meat on cooking might be due to the increased salt concentration and change in the net charge of proteins due to denaturation. Out of all the treatments, the WPC recorded the highest pH (6.28). Increase in the pH of meat on addition of WPC has been reported by Boye *et al.* (1997). It is concluded that WPC (4%) and starch (4%) can be used to replace fat in chevon meat rolls which is usually added for desirable organoleptic properties.

## REFERENCES


AOAC (1995). Official Methods of Analysis, 16th edn., Association of Official Analytical Chemists, Washington, D.C., U.S.A.

Babu, N.P., Kowale, B.N., Rao, V.K. and Bisht, G.S. (1994). Effect of cooking and storage on lipid oxidation and development of cholesterol oxides in chicken meat. *Indian J. Poult. Sci.* **29:** 254-262.

Bater, B., Descamps, O. and Maurer, A.J. (1992). Quality characteristics of hydrocolloid –added oven roasted turkey breasts. *J. Food Sci.* **57:** 1068-1070.

Boye, J.I., Alli, I., Ramaswamy, H. and Raghavan, V.G.S. (1997). Interactive effects of factors affecting gelatoin. *J. Food Sci.* **62:** 57-65.

Giese, J. (1996). Fats, oils and fat replacers. *Food Technol.* **50**: 78-84.

Huffman, L.M. (1996). Processing whey protein for use as a food ingredient. *Food Technol.* **50**: 49-52.

Hughes, E., Cofrades, S. and Troy, D.J. (1997). Effects of fat level, oat fibre and carrageenan on frankfurters Formulated with 5, 12 and 30% fat. *Meat Sci.* **45**: 273-281.

Hughes, E., Mullen, A.M. and Troy, D.J. (1998). Effects of fat level, tapioca starch and whey protein on frankfurters formulated with 5 % and 12 % fat. *Meat Sci.* **48**: 169-180.

Keeton, J.T. (1994). Low fat meat products - technological problems with processing. *Meat Sci.* **36**: 261-276.

Knipe, C.L., Olson, D.G. and Rust, R..E. (1985). Effects of selected inorganic phosphates, phosphate levels and reduced sodium chloride levels on protein solubility, stability and pH of meat emulsions. *J. Food Sci.* **50:** 1010-1013.

Lin, K.W. and Keeton, J.T. (1998). Textural and physico chemical properties of low fat, precooked ground beef patties containing carrageenan and sodium alginate. *J. Food Sci.* **63**: 571-574.

Lyons, P.H., Kerry, J.F., Morrissey, P.A. and Buckley, D.J. (1999). The influence of added whey protein/carrageenan gels and tapioca starch on textural properties of low fat pork sausages. *Meat Sci.* **51**: 43-52.

Prabhu, G.A. and Sebranek, J.G. (1997). Quality characteristics of ham formulated with modified corn starch and kappa carrageenan. *J. Food Sci.* **62**: 198-202.

Rao, K.H., Rao, K.V.S.S., Singh, R.R.B., Anjaneyulu, A.S.R. and Yadav, P.L (1999). Milk proteins as emulsion stabilizers in comminuted meat products. *Indian Food Industry*. **18**: 287-298.

Saffle, R.L., Christian, J.A., Carpenter, J.A. and Zirkle, S.B. (1967). Rapid method of determination of stability of sausages emulsions and effects of processing temperatures and humidities. *Food Technol.* **21**: 784-788.

Snedecor, G.W. and Cochran, W.G. (1980). *Statistical Methods*. Oxford and IBH Publishing Co., Calcutta.

Trout, E.S., Hunt, M.C., Johnson, D.E., Clans, J. R., Castner, C.L. and Kropf, D.H. (1992). Characteristics of low fat ground beef containing texture modifying ingredients. *J. Food Sci.* **57**: 19-24.

Whiting, R.C. and Jenkins, R.K. (1981). Comparison of rabbit, beef and chicken meats for functional properties and frankfurter processing. *J. Food Sci.* **46**: 1693-1696.

Yadav, S. and Sharma, D.P. (2005). Selection of suitable level of whey protein concentrate, guar gum and starch for use as fat replacers in goat meat rolls. *Indian Food Packer*. **59**: 69-74.