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# Role of dietary fibre (Corn bran and apple pomace) in processed meat products : A review

**Jai Parkash, DP Sharma and S Yadav**

**Abstract**
Dietary fibre constitutes a mixture of chemical entities which includes non-digestible carbohydrate, lignin and other associated substances of plant origin, fibres of animal origin and modified or synthetic non-digestible carbohydrate polymers. Chevon rolls are made using dried apple pomace (DAP) at 2, 4 and 6% levels and corn bran (CB) at 3, 6 and 9% levels. Combinations of DAP and CB were also tried. DAP at 6% level, CB at 3% level and their combination (DAP +CB) at 2% + 3% levels were found to be organoleptically acceptable and selected for further study. Addition of fibre resulted in a significant ($p \leq 0.05$) decrease in moisture and protein content while no significant difference was found in fat and ash content. Crude fibre content increased significantly in treated rolls and highest crude fibre content (1.68%) was noticed in rolls containing DAP. pH decreased signifi cantly in rolls containing DAP and its combination. Water holding capacity and emulsion stability of chevon rolls increased significantly as a result of fibre incorporation which also resulted in a significant increase in cooking yield. Polyphenolic content increased in fiubre enriched rolls and highest polyphenolic content of 49.22 mg/100 g was found in DAP added chevon rolls. It is concluded that organoleptically acceptable and health enhancing chevon rolls enriched with dietary fibre and antioxidants like polyphenols can be prepared by using different ditary fibres.

**Keywords:** chevon rolls, corn bran, dried apple pomace, dietary fibre, polyphenols

## Introduction

A diet high in fibre generally promotes a healthier life style (Kritchevsky, 2000) [24] and fibre intake can be viewed as a marker of healthy diet. According to current recommendations (Food and Nutrition Board, 2001), the average daily requirement of dietary fibre is 25 g per day for women younger than 50, 21 g per day for women older than 50, 38 g per day for men younger than 50 and 30 g per day for men older than 50. The chemical nature of fibres is complex. Dietary fibre constitutes a mixture of chemical entities which includes non-digestible carbohydrate, lignin and other associated substances of plant origin, fibres of animal origin and modified or synthetic non-digestible carbohydrate polymers.

Classification of dietary fibre components

| Fibre Constituent | Principal groupings | Fibre component /sources |
|---|---|---|
| Non-starch polysaccharides and oligosaccharides | Cellulose | Cellulose plants (vegetable, sugar beet, various brans) |
| | Hemi-cellulose | Arabinogalactans, glucans, arabinoxylans glucuronoxylans, xyloglucans, galactomannans, pectic substances |
| | Polyfructoses | Inulin, oligofructans |
| | Gums and mucilages | Seed extracts (galactomannans – guar and locust bean gum), tree exudates (gum acacia, gum karaya, gum tragacanth), algal polysaccharides (alginates, agar carrageenan), psyllium |
| Carbohydrate analogues | Pectins | Fruits, vegetables, legumes, potato, sugar beets |
| | Resistant starches and maltodextrins | Various plants such as maize, pea, potato |
| | Chemical synthesis | Polydextrose, lactulose, cellulose derivatives |
| | Enzymatic synthesis | Neosugar or short chain fructooligosaccharides, transgalactooligosaccharides, levan, xanthan gum, oligofructose, xylooligosaccharide, guar hydrolyzate, curdlan |
| Lignin | Lignin | Woody plants |
| Substances associated with non starch polysaccharides | Waxes, cutin, suberin | Plant fibres |
| Animal origin fibres | Chitin, chitosan, collagen, chondroitin | Fungi, yeasts, invertebrates |

(Tungland and Meyer, 2002) [35]

**Functional properties of dietary fibres**
Fibre is suitable for meat products preparation because of its water retention property, ability to decrease cooking loss and neutral flavour. Dehydrated fruit, vegetable and cereal fibre can be used in the food industry as functional ingredient with excellent results (Viuda-Martos *et al.*, 2010) [38].

The functional properties of some important dietary fibres

| Fibre Type | Functions in meat products |
|---|---|
| Alginate oligosaccharides stabilizer | Functional foods (humectants, thickener and stabilizer) |
| Konjac (flour) mannan carrageenan and gum for gelling gum | Binder in meat, often used with k- xanthan Thickener, texture modifying agent etc |
| Guar gum oligosaccharides | Functional foods |
| Inulin-type (onion, chicory root etc) | Fat/sugar replacement, texture modification |
| Pectin (apples, citrus, sunflowers, sugar beet) | Gelling agent, texture modifying agent etc |
| Carrageenan (from red algae) | Fat replacer, improves water holding capacity |
| Microcrystalline cellulose extracted from wood pulp, bamboo, wheat, cottonseed hulls | Improves water holding capacity |
| Modified cellulose (MC, CMC, MHPC) by chemical reaction of cellulose | Thickener, stabilizer, humectants |
| Chitosan (shrimp, crabs etc) | Improves viscosity, gelation |
| β-glucan (oat, barley, wheat flour etc) | Binder, extender etc. |
| Psyllium seed husk | Functional food development as a fibre source |

Biswas *et al.* (2011) [3]

**Corn bran**
Corn fibre is an agro-industrial derived byproduct, which arise during starch and flour production and is associated with high dietary fibre content. Cell walls of monocotyledons consist mainly of cellulose, hemicelluloses and pectin. They also contain numerous hydroxycinnamic acids mainly covalently bound to polysaccharides via ester linkages (Gallardo *et al.*, 2006) [17].

Composition of corn bran

| Constituents | Corn bran (g/kg) | References |
|---|---|---|
| Protein | 50-115 | Saulnier *et al.*,1995 [32]; Bonnin *et al.*, 2002 [4] |
| Starch | 40-112 | Saulnier *et al.*, 1995 [32]; Chanliaud *et al.*, 1995 [5] |
| Ash | 6-10 | Chanliaud *et al.*,1995 [5]; Bonnin *et al.*,2002 [4] |
| Total dietary fibre (TDF) | 732-860 | Saulnier *et al.*,1995 [32]; Kahlon and Chow, 2000 [23] ; Dikeman *et al.*, 2006 |
| Soluble fibre | 2-26 | Kahlon and Chow, 2000 [23] ; Dikeman *et al.*, 2006 |
| Insoluble fibre | 706-863 | Kahlon and Chow, 2000 [23] ; Dikeman *et al.*, 2006 |
| Total phenolics | 55 | Saulnier *et al.*,1995 [32] |
| Ferulic acid | 28-31 | Saulnier *et al.*,1995 [32]; Bonnin *et al.*,2002 [4]. |

**Apple pomace**
Apple is a well known and widespread fruit of genus Malus (about 25 species) belonging to family Rosaceae. Gorinstein *et al.* (2001) investigated the dietary fibre levels of whole apple, pulp and peel. They reported that the majority of the total fibre was located in the peel of the apple. They also found that apple peels contain significant levels of calcium, magnesium, zinc, iron and copper. Citrus and apple fibres have better quality than other dietary fibres due to the presence of associated bioactive compounds such as flavonoids, polyphenols and carotenes (Fernandez-Gines *et al.*, 2003; Wolfe and Liu, 2003) [13, 39].
Ganai *et al.* (2006) [18] reported that apple pomace contains 7.31-8.53 % crude protein, 2.6-3.3 % ether extract, 19.34-20.66 % crude fibre and 3.85-4.7 % total ash. The average values for moisture, protein, ether extract, ash and crude fibre content in apple pomace were 9.75 %, 5.11 %, 3.12 %, 3.97 % and 20.06 % respectively (Gazalli *et al.*, 2013) [20].

**Effect of fibre addition on physico-chemical properties of meat pH**
The change in pH on addition of dietary fiber source largely depends upon the pH of the fiber source added and fibre ddition results in an alteration in pH of meat (Mehta *et al.*, 2013) [27]. Goat meat patties having kinnow rind powder extract had lower pH (6.02) as compared to control (6.23). It was attributed to acidic pH of extracts by Devatkal *et al.* (2010) [10, 11].
Rye bran was incorporated at four different levels viz. 5, 10, 15 and 20 % and results revealed that the pH increased significantly at 10 % level as compared to control (Yilmaz, 2004) [41]. Talukdar and Sharma (2010) incorporated wheat bran and oat bran at 5, 10 and 15 % levels in chicken meat patties. They reported an increase in pH of emulsion as well as cooked product on incorporation of wheat bran. Addition of dietary fibre does not influenced the water activity and pH values of dry fermented sausages (Mendoza *et al.*, 2001; Garcia *et al.*, 2002) [28, 19]. With increasing concentration of fibre, pH decreased progressively (Fernandez-Lopez *et al.*, 2007) [15]. Verma *et. al.* (2010) [37] reported a significant decrease in pH of low fat chicken nuggets after apple pulp inclusion and partial replacement of sodium chloride with salt substitutes.

**Water holding capacity, emulsion stability and cooking yield**
Fibre is suitable for addition in meat products and has been previously used in cooked meat products to increase the water holding capacity (Cofrades *et al.*, 2000) [8] which ultimately results in higher emulsion stability and cooking yield (Mehta *et al.*, 2013) [27]. Dietary fibres increase cooking yield due to their water and fat binding properties and improve texture in cooked meat products (Cofrades *et al.*, 2000) [8]. Grigelmo-Miguel and Martin-Belloso (1999) [22] stated that peach

dietary fibre was effective in retaining added water in low fat high dietary fibre frankfurters. Emulsion stability and cooking yield increased on incorporation of rice bran at different levels in meat batters (Choi *et al.*, 2007) [7]. Fibre retains water, decreases cooking losses and has neutral flavour (Verma and Banerjee, 2010) [37]. Yasarlar *et al.* (2007) reported a decreased weight loss during cooking after incorporation of different types of bran (rye, wheat, corn, oat) to turkish meat balls.

**Shear press value**

Garcia *et al.* (2002) [19] observed that dry fermented sausages added with peach, apple and orange fibres showed reduced hardness due to the ability of fibre to reduce losses and retention of moisture.

Aleson-Carbonell *et al.* (2004) [1] reported that shear press value increased during drying process of non fermented dry sausages. Use of full fat soya paste in development of goat meat patties resulted in decrease in shrinkage, hardness, springiness, chewiness and shear force values (Das *et al.*, 2006) [9].

Progressive increase in cereal bran (wheat, oat, rye and corn) content resulted in an increase in firmness of turkish meat balls. Highest firmness was noted in 20 % oat bran added meat balls (Yasarlar *et al.*, 2007).

**Effect on sensory quality**

Mansour and Khalil (1997) [26] reported that overall palatability of low fat beef burgers was not affected by the addition of wheat fibres. Yilmaz (2004) [41] reported that there was a significant difference among the rye bran added meat balls in respect to sensory properties.

Garcia *et al.* (2002) [19] reported that addition of cereal (wheat and oat) and fruit (peach, apple, orange) fibres to dry fermented sausage upto 1.5 % level did not result in any significant changes in sensory properties. Addition of wheat, oat and peach at 3 % level resulted in significant decline in overall acceptability. Wheat and oat fibre significantly increased the hardness of meat products. Fruit fibre addition produced sausages that were less harder and more elastic.

Inclusion of fibres in meat products increased hardness (Fernandez-Gines *et al.*, 2004) [14]. Meat balls with rusk showed highest penetration values than meat balls with the chickpea flour (Serdaroglu *et al.*, 2005) [33] as swelling of the starch component of rusk interacted with the protein of meat to form a softer texture thus leading to an increase in penetrometer values.

Lin and Lin (2004) [25] reported that addition of bacterial cellulose (Nata) in Chinese style meatball resulted in detrimental effect on textural attributes. The values for hardness, cohesiveness, springiness, chewiness and shear force showed a decreasing pattern with an increasing level of Nata incorporation.

Fernandez- Gines *et al.* (2004) [14] reported that bolognas formulated with lemon albedo showed higher lightness (L*) and redness (a*) compared to control. Addition of hazelnut pellicle in beef burgers (Turhan *et al.*, 2005) and low fat meat products (Dolatowski and Karwowska, 2006) [12], rice bran in meat batter (Choi *et al.*, 2007) [7] reduced lightness (L*) and yellowness (b*) values but increased redness (a*) values than control. Lightness and redness as measured by hunter lab decreased with more bran addition. Increasing amount of bran resulted in masking of meaty flavour (Yasarlar *et al.*, 2007).

Yilmaz and Gegel (2009) [40] reported that sensory scores of veal meatballs with 10, 15 and 20 % added inulin were less acceptable than control due to hardness, low juiciness and low flavor intensity.

Saricoban *et al.* (2009) adopted a three factor Box- Behnken design for studying the simultaneous effects of ingredients variables such as fat (10–30 %), wheat bran (5–15 %) and NaCl (0–2 %) on physico-chemical, textural and sensory properties of cooked beef patties.

Rupasinghe *et al.* (2009) [31] concluded that the replacement of wheat with 16 % apple skin powder results in favourable sensory scores in muffins.

The addition of orange dietary fibre in mortadellas led to a significant increase in hardness and a decrease in springiness and chewiness as compared to control (Viuda-Martos *et al.*, 2010) [38]. Choi *et al.* (2011) [6] found that heat induced gels incorporated with rice bran fibre had lower hardness, springiness, cohesiveness, gumminess and chewiness as compared to control.

**Thiobarbituric acid (TBA) value**

Oxidation of lipids in meat and meat products causes significant decline in organoleptic properties of meat during storage. Ascorbic acid, tocopherols, tea catechins, polyphenols have been shown to prevent lipid oxidation in meat products (Devatkal *et al.*, 2010) [10, 11].

Polyphenolic extract from citrus peels caused a marked reduction in lipid oxidation in various organs in vitro (Oboh and Admosun, 2006) [29]. Fernandez-Gines *et al.* (2003) [13] reported that TBA value increased faster during storage of control bologna than in samples with citrus fibre. Aleson-Carbonell *et al.* (2004) [1] reported that non fermented dry cured sausages formulated with lemon albedo had lower Thiobarbituric acid reacting substances (TBARS) values than control samples at the end of storage.

Devatkal and Naveena (2010) [10, 11] indicated that kinnow rind powder and pomegranate rind powder countered the prooxidant effect of salt in raw ground goat meat during refrigerated storage. Kinnow rind powder extract showed excellent radical scavenging activity and its addition to goat meat patties resulted in lower increase of TBARS value during storage (Devatkal *et al.*, 2010) [10, 11].

Alvarez *et al.* (2011) [2] found that the antioxidant activity of rice bran added frankfurters was preserved till 14 days of storage showing an efficient protection against lipid oxidation.

Prasad *et al.* (2011) [30] reported that oat flour had better inhibition of oxymyoglobin oxidation when added in chicken kofta as compared to control. The product was microbiologically safe and sensorily acceptable during the 15 days of storage.

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