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Effect of Dried Apple Pomace and Corn Bran Incorporation on Quality Characteristics of Chevon Rolls During Refrigerated Storage

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ABSTRACT

An investigation was conducted to assess the effect of incorporation of dried apple pomace (DAP) and corn bran (CB) as dietary fibre sources on organoleptic, thiobarbituric acid reacting substance (TBARS) value and microbial quality characteristics of chevon rolls during refrigerated storage. DAP, CB and their combination (DAP+CB) were used at 6%, 3% and 2%+ 3% level respectively by replacing lean meat. Both control and treated chevon rolls were packaged in polythene bags and stored at a temperature of 4 ± 1^0C. Parameters were analysed at a regular interval of 4 days. There was a decrease in sensory quality of control and treated rolls during refrigerated storage. But organoleptic scores of control as well as fibre enriched rolls for different sensory attributes were around 7.0 on 12^{th} day of refrigerated storage meaning moderate acceptability. TBARS value increased significantly during storage in all the treatments but DAP was most effective in checking increase in TBARS value. Total plate count, psychrotrophic count and yeast and mould counts increased significantly during storage but all the microbial counts were within the acceptable limit up to 12^{th} day of refrigerated storage. *Escherichia coli*, *Staphylococcus aureus* and S*almonella* were not detected during storage period in any of the treatments. It is concluded that fibre enriched chevon rolls with organoleptic acceptability and microbiological safety up to 12 days of refrigerated storage can be prepared by incorporating dried apple pomace, corn bran and their combination each at 6%, 3% and 2%+3% level respectively.

Keywords: Refrigerated storage, chevon rolls, dried apple pomace, corn bran, microbial count

Meat is an excellent source of proteins and suits human diet due to its satiating characteristics. However, its regular eating is being related with occurrence of a range of health disorders like obesity, colon cancer and cardiovascular diseases (Larsson and Wolk, 2006; Tarrant, 1998). So there is a need to uplift the image of meat as a healthy food. In this aspect, dietary fibre is one of the components which can be incorporated in the meat. Supplementation with dietary fibre can result in fitness promoting meat products which are low in calories, cholesterol and fat. Diets rich in dietary fibre are associated with the prevention of coronary atherosclerosis and other diseases (Bartnikowska, 1999).

Fibre is suitable for meat products preparation because of its water retention property, ability to decrease cooking loss and neutral flavour. Dietary fibres isolated from various plants have diverse functional properties namely solubility, viscosity, gel forming ability, water-binding capacity, oil adsorption capacity, mineral and organic molecule binding capacity which affect product quality characteristics (Tungland and Meyer, 2002). Corn bran is an agro-industrial derived byproduct which arises during starch and flour production and is associated with high dietary fibre content. Apple pomace is the residue which remains after the extraction of juice from apple and is a byproduct of apple juice industry. It is not only a good source of total dietary fibre but also contains significant amount of soluble dietary fibre which comprises of pectin (Shah and Masoodi, 1994). Apple pomace and corn bran are not only a good source of dietary fibre but also contain polyphenols and bioactive compounds. Apples contain many types of phenolic acid derivatives and flavonoids (Mangas *et al.* 1999; Shoji *et al.* 2003) which have antioxidant properties. Ferulic acid, a phenolic antioxidant

present in corn bran also possesses antimicrobial activity against spoilage and pathogenic microorganisms (Tsou *et al.* 2000). Aleson-Carbonell *et al.* (2004) 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 indicating the protective effect of albedo against the oxidation process due to associated bioactive compounds. Alvarez *et al.* (2011) also found that antioxidant activity of rice bran added frankfurters was preserved till 14 days of storage showing an efficient protection against lipid oxidation.

Very few studies have been carried out to assess the effect of dried apple pomace and corn bran incorporation on quality of meat products during refrigerated storage. Keeping above points in view, this investigation was carried out to study the effect of dried apple pomace and corn bran incorporation on organoleptic, thiobarbituric acid reacting substance (TBARS) and microbiological quality of chevon rolls during refrigerated storage.

MATERIALS AND METHODS

Procurement and processing of dietary fibre sources

Apples were procured from local market. They were washed with clean water and juice was extracted in juicer in the department. Apple pomace obtained after extraction of juice was washed gently with clean water. Water was removed from apple pomace by squeezing in muslin cloth and it was dried at 60ºC in tray drier. Dried pomace was powdered in a grinder, packed in a polythene bag and stored in deep freezer (-18ºC) for further use. CB was procured from Vitarich Pvt. Ltd., Kolkata.

Processing of goats

The goats were slaughtered and dressed as per the standard procedure in the slaughter house of the department. Carcasses were washed to remove extraneous material. Visible fat and connective tissue was trimmed and deboning of carcasses was carried out. Deboned meat was frozen for 24 hours in a deep freezer (-18ºC) and then minced in an electrical mincer for preparation of chevon rolls.

Preparation of chevon rolls

For preparation of control chevon rolls, minced meat (77.2 g) was added with sodium chloride (1.6 g), sodium tripolyphosphate (STPP) (0.3 g), sodium nitrite (0.015 g), spice mix (1.9 g), condiments paste (3 g), egg albumin (3 g), water (8 g) and ground nut oil (5 g). Treatments consisted of addition of DAP and CB individually at 6% level and 3% level respectively by replacing lean meat. Combination of DAP + CB was also used at 2% + 3% level. Levels of DAP, CB and their combination were selected on the basis of an earlier study (Parkash, 2014). Other ingredients were used in similar concentrations as in control. Mixing of additives and dietary fibre sources was carried out in an electrical mixer for 4-5 min to prepare emulsion.

Steam cooking was done for preparation of chevon rolls. Emulsion was stuffed in autoclavable beakers manually and cooked in a closed container for 30 minutes. After cooking, rolls were taken out and cooled to room temperature, packaged in polythene bags and stored at refrigerated temperature for further study.

Final treatments were as follows:

1. Control – Chevon rolls without dietary fibre incorporation
2. DAP-3 – Chevon rolls incorporated with 6% DAP.
3. CB-1 – Chevon rolls incorporated with 3% CB.
4. AC-1 – Chevon rolls incorporated with 2% DAP +3% CB.

Analysis

A semi trained panel consisting of four members from scientists and post graduate students of the department evaluated the sensory attributes viz: colour, flavour, texture, tenderness, juiciness and over all acceptability (OAA) of chevon rolls using a 9-point Hedonic scale (where 9 indicates like extremely and 1 indicates dislike extremely).

TBARS value was determined according to the method of Witte *et al*. (1970). Microbial counts were determined as per method prescribed by APHA (1984). Total plate count (TPC) and psychrotrophic count (PC) were determined using plate count agar (Hi-media) whereas potato-

Table 1: Sensory scores of dried apple pomace, corn bran and their combination incorporated chevon rolls during refrigerated storage

Treatment	0 day	4th day	8th day	12th day
		Colour		
Control	7.75±0.62^{B}	7.70±0.33^{B}	7.75±0.69^{B}	7.66±0.49^{B}
DAP-3	8.46±0.54^{A}	8.25±0.45^{A}	8.29±0.54^{A}	8.25±0.45^{A}
CB-1	7.63±0.64^{B}	7.58±0.63^{B}	7.33±0.65^{B}	7.33±0.53^{B}
AC-1	7.75±0.45^{B}	7.79±0.68^{B}	7.79±0.63^{B}	7.58±0.63^{B}
		Flavour		
Control	7.95±0.45 ^{aA}	7.75±0.78^{ab}	7.58±0.63^{ab}	7.33±0.49 ^{b}
DAP-3	7.46±0.45^{AB}	7.50±0.60	7.25±0.62	7.25±0.69
CB-1	7.42±0.47^{aB}	7.20±0.54^{ab}	7.04±0.58^{ab}	6.87±0.60^{b}
AC-1	7.33±0.57^{B}	7.29±0.75	7.04±0.62	7.08±0.66
		Texture		
Control	7.88±0.53^{A}	7.75±0.72	7.66±0.78	7.41±0.55
DAP-3	7.25±0.45^{B}	7.25±0.75	7.20±0.58	7.12±0.67
CB-1	7.50±0.71^{AB}	7.41±0.63	7.37±0.48	7.16±0.57
AC-1	7.33±0.61^{B}	7.42±0.59	7.20±0.39	7.00±0.42
		Juiciness		
Control	7.96±0.58^{aA}	7.62±0.64^{ab}	7.20±0.58^{b}	7.33±0.61^{b}
DAP-3	7.21±0.41^{B}	7.33±0.77	7.16±0.77	7.08±0.66
CB-1	7.58±0.55^{AB}	7.25±0.62	7.16±0.38	7.16±0.49
AC-1	7.29±0.58^{B}	7.45±0.39	7.12±0.52	7.00±0.56
		Tenderness		
Control	8.00±0.43^{aA}	7.95±0.65^{aA}	7.66±0.49^{abA}	7.41±0.41^{b}
DAP-3	7.33±0.65^{B}	7.25±0.65^{B}	7.20±0.62^{B}	7.08±0.70
CB-1	7.46±0.50^{B}	7.41±0.51^{B}	7.12±0.53^{B}	7.16±0.44
AC-1	7.25±0.39^{B}	7.25±0.34^{B}	7.20±0.45^{B}	7.08±0.59
		Overall acceptability		
Control	7.96± 0.62^{A}	7.75± 0.45	7.75±0.62	7.41±0.51
DAP-3	7.25±0.40^{B}	7.20±0.62	7.25±0.58	7.25±0.50
CB-1	7.50±0.52^{AB}	7.36± 0.81	7.29±0.86	7.00±0.82
AC-1	7.29±0.45^{B}	7.27± 0.79	7.20±0.94	7.12±0.77

(n=12, Mean ±SD)

DAP-3= dried apple pomace (6%), CB-1= corn bran (3%), AC-1=dried apple pomace (2%) +corn bran (3%) respectively. Means with different small superscripts within a row and capital superscripts within a column for a particular parameter differ significantly ($p \leq 0.05$).

dextrose-agar (Hi-media) was used to detect yeast and mould counts. Eiosin-methylene blue agar (Hi-Media) for *E. coli* count, Baired Parker agar (Hi-Media) for *Staphylococcus aureus* count and Brilliant Green Medium (Hi-Media) for presence of *Salmonella* spp were used.

Data obtained from six replicates were subjected to statistical analysis using Duncans Multiple range test by using SPSS software for finding out the significant difference in the mean values. Critical difference was determined at 5 % level of significance.

RESULTS AND DISCUSSION

Sensory scores of DAP and CB incorporated chevon rolls during refrigerated storage

Sensory evaluation of the products was carried out only up to 12 days of refrigerated storage as all the products spoiled on 16th day. Sensory scores of control and treated chevon rolls have been shown in Table 1. Control chevon rolls had colour score of 7.75. Colour score of DAP-3

Table 2: TBARS value (mg malondehyde/kg) and microbiological quality of dried apple pomace, corn bran and their combination incorporated chevon rolls during refrigerated storage

Treatment	0 Day	4th Day	8th Day	12th Day	16th Day
			TBARS value		
Control	0.95± 0.14^{e}	1.21±0.16^{d}	1.74±0.18^{c}	2.11±0.12^{bA}	2.50±0.11^{aA}
DAP-3	1.01±0.13^{e}	1.25±0.11^{d}	1.58±0.18^{c}	1.79±0.18^{bB}	2.17±0.17^{aB}
CB-1	0.88±0.12^{e}	1.31±0.11^{d}	1.76±0.11^{c}	2.10±0.09^{bA}	2.43±0.12^{aA}
AC-1	0.93±0.12^{e}	1.17±0.08^{d}	1.65±0.13^{c}	2.03±0.14^{bA}	2.38±0.19^{aA}
			Standard plate count (log cfu/g)		
Control	2.95± 0.26^{e}	3.55±0.25^{d}	4.29±0.27^{c}	5.44±0.29^{b}	6.25±0.35^{a}
DAP-3	3.11±0.36^{d}	3.40±0.28^{d}	4.22±0.27^{c}	5.23±0.36^{b}	6.10±0.41^{a}
CB-1	3.19±0.46^{d}	3.45±0.21^{d}	4.03±0.24^{c}	5.30±0.31^{b}	6.16±0.30^{a}
AC-1	3.03±0.38^{d}	3.27±0.46^{d}	4.14±0.28^{c}	5.14±0.34^{b}	5.99±0.29^{a}
			Psychrotrophic count (log cfu/g)		
Control	1.48±0.42^{d}	1.99±0.29^{c}	2.50±0.29^{b}	2.83±0.33^{b}	3.30±0.40^{a}
DAP-3	1.45±0.35^{d}	1.95±0.26^{c}	2.34±0.25^{c}	2.76±0.36^{b}	3.17±0.42^{a}
CB-1	1.26±0.21^{d}	1.76±0.32^{c}	2.39±0.27^{b}	2.66±0.29^{b}	3.35±0.40^{a}
AC-1	1.34±0.30^{d}	1.84±0.23^{c}	2.60±0.30^{b}	2.91±0.24^{ab}	3.23±0.47^{a}
			Yeast and mould count (log cfu/g)		
Control	1.23±0.43^{e}	1.73±0.32^{d}	2.29±0.29^{c}	2.70±0.30^{b}	3.25±0.32^{a}
DAP-3	1.49±0.25^{c}	1.66±0.42^{c}	2.17±0.36^{b}	2.80±0.36^{a}	3.09±0.31^{a}
CB-1	1.32±0.24^{c}	1.68±0.37^{c}	2.39±0.39^{b}	3.04±0.28^{a}	3.30±0.22^{a}
AC-1	1.42±0.42^{d}	1.54±0.29^{d}	2.25±0.26^{c}	2.82±0.32^{b}	3.36±0.42^{a}

(n=6, Mean ±SD)
DAP-3= dried apple pomace (6%), CB-1= corn bran (3%), AC-1=dried apple pomace (2%) +corn bran (3%) respectively.
Means with different small superscripts within a row and capital superscripts within column differ significantly ($p \leq 0.05$).

treatment was significantly higher than control, CB-1 and AC-1 treatments on 0 day as well as during storage. This might be due to red colour of apple pomace (containing peel) which contributed to desirable redness in DAP-3 treatment. No significant difference was noticed in colour scores in any of the treatments with the increase in storage period. All the treatments were able to maintain acceptable colour even after 12 days of storage.

Incorporation of fibre resulted in a decrease in flavour scores of treated rolls and significant difference in comparison to control was observed in treatments CB-1 and AC-1. Addition of apple pomace and corn bran resulted in a decrease in meaty flavour of chevon rolls which resulted in decreased flavour scores. A significant decrease in flavour scores of chicken patties and rolls after incorporation of combination of rice bran and psyllium husk (Mehta *et al.* 2013a) and black gram hull and psyllium husk (Mehta *et al.* 2013b) was observed. Significant decline in flavour scores of control and CB-1 treatments was noticed on 12th day of storage, whereas, no significant difference was noticed in flavour scores of DAP-3 and AC-1 treatments during storage. Presence of polyphenols in DAP-3 and AC-1 treatments resulted in less development of oxidative rancidity which resulted in less deterioration in flavour. CB-1 treatment had flavour scores below 7.0 on 12th day. This might be due to deteriorative changes in CB.

Texture score decreased on addition of fibre and treatments DAP-3 and AC-1 had significantly lower texture score than control on 0 day. This might be due to increase in hardness as fibre addition in meat products increases hardness (Fernandez-Gines *et al.* 2004). Lin and Lin (2004) had also reported that addition of bacterial cellulose (Nata) in Chinese style meatball resulted in detrimental effect on textural attributes. Non significant decline in texture scores was noticed in control and treated rolls at the end of storage period. However, texture scores of all the treatments were above 7.0 at the end of storage period.

Juiciness score of fresh control treatment was significantly higher than fresh DAP-3 and AC-1 treatments. This might be due to significantly lower moisture content in DAP-3 treatment and AC-1 treatment in comparison to control. Juiciness score of control treatment decreased significantly on 8th day of storage and reached to 7.2. Non significant decline in juiciness scores of treated rolls was noticed with the increase in storage period. All the treatments were having juiciness scores around 7.0 at 12th day of storage meaning that control and treated rolls were moderately acceptable with regard to juiciness even at the end of storage period of 12 days.

Tenderness score of control treatment was significantly higher than fibre enriched treatments. Fibre incorporation resulted in more hardness in rolls resulting in decline in tenderness scores of fibre enriched rolls. Significant decline in tenderness scores was noticed in control treatment on 12th day of storage. This might be due to loss of moisture during storage. Tenderness scores of fibre enriched treatments declined non-significantly.

Overall acceptability score of fresh control rolls was significantly higher than DAP-3 and AC-1 treatments. Higher flavour, texture, juiciness and tenderness scores of control rolls in comparison to treated rolls resulted in higher overall acceptability scores. The scores for overall acceptability declined non significantly during storage in all the treatments. No significant difference was noticed in overall acceptability scores between control and treated rolls at the end of storage. The scores for treated rolls were around 7.0 at the end of storage period meaning that all the treated rolls were moderately acceptable at 12th day of refrigerated storage.

TBARS value

TBARS value of control and treated rolls ranged from 0.88 to 1.01 mg malondehyde/kg and the difference in the values was non-significant (Table 2). TBARS values increased significantly with the increase in storage period in all the treatments. But the increase in TBARS value was less in DAP-3 treatment resulting in significantly lower value in DAP-3 treatment in comparison to other treatments at the end of storage. This might be due to antioxidant and radical scavenging effect of polyphenols present in apple pomace. Yadav *et al.* (2016) reported a significantly lower TBARS value in dried apple pomace and dried tomato pomace treated sausages as compared to control on 15th day of refrigerated storage. TBARS value in CB-1 and AC-1 treatments was non significantly lower than control on 12th day of storage.

Microbiological quality

No significant difference was found between control and treated rolls in TPC, PC and yeast and mould counts on 0

day as well as during storage (Table 3). The results show that fibre incorporation did not result in any significant effect on microbiological counts. Similar results were observed by Yadav *et al.* (2016) in corn bran, dried apple pomace and dried tomato pomace incorporated chicken sausages. Significant increase in all the counts was observed with increase in storage period in control as well as treated rolls. TPC count reached to more than 5 log cfu/g on 12th day of storage. On 16th day of storage, TPC count was around 6 log cfu/g making the products unacceptable as the microbial population exceeded 10^6 (Frazier and Westhoff, 1978). *Escherichia coli, Staphylococcus aureus* and *Salmonella* sp were not detected in any of the treatments during storage period. Better hygienic conditions followed during manufacturing of meat rolls resulted in absence of above mentioned pathogenic organisms.

CONCLUSION

Chevon rolls prepared by incorporating 6% dried apple pomace, 3% corn bran and their combination [dried apple pomace (2%) +corn bran (3%)] were microbiologically safe and organoleptically acceptable up to 12th day of refrigerated storage.

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