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Priyanka Meena
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Anurag Pandey
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Asman Singh Gurjar
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Ravi Raman
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Shrawan Kumar Meel
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Sunil Rajoria
Department of Veterinary and Animal Husbandry Extension Education, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Corresponding Author
Priyanka Meena
Department of Livestock Products Technology, Post Graduate Institute of Veterinary Education and Research, Jaipur, Rajasthan, India

Impact of green coffee extract on the quality attributes of lab prepared chevon nuggets during refrigeration storage

Priyanka Meena, Anurag Pandey, Asman Singh Gurjar, Ravi Raman, Shrawan Kumar Meel and Sunil Rajoria

Abstract
The present study was carried out to evaluate the antioxidant potential of green coffee extract (GCE) and its effect on the physico-chemical, microbiological and sensory properties of chevon nuggets during refrigeration storage. The chevon nugget treated with (GCE) had significantly (P<0.05) lower thiobarbituric acid reactive substance (TBARS) and free fatty acid % (FFA) compared to control during storage at 4 ± 1 ºC. Addition of GCE significantly (P<0.05) reduced the total plate, total psychrophilic and yeast & mold count in chevon nuggets during refrigeration storage. The GCE treated chevon nuggets recorded significantly (P<0.05) superior score of flavor and overall acceptability than control. It can be concluded that GCE has excellent antioxidant properties, could be used as an antioxidant to meat products without affecting its quality and acceptability.

Keywords: Antioxidant, chevon nuggets, green coffee, microbiological, physico-chemical

1. Introduction
Lipid oxidation is one of the major causes of deterioration in the quality of meat and meat products. It may decrease the nutritional value by forming potential toxic products during cooking and processing (Shahidi *et al*., 1992; Maillard *et al*., 1996) [22, 16], lead to extensive flavour changes, colour losses and structural demage to protein leading to loss of freshness that discourage repeated purchases by consumer. Oxidation of unsaturated fatty acids in cooked meats during storage and reheating results in stale or rancid flavours known as warmed-over flavour (Sato and Hegarty, 1971) [21]. Unsaturated lipids, especially those of the membrane phospholipid fraction, are the compounds undergoing auto-oxidation (Igene and Pearson, 1979; Younathan and Watts, 1960) [10, 29]. Antioxidants are compounds or substances, synthetic or naturally occurring that can retard lipid oxidation and prolong shelf life of meat products. In industrial processing, mainly synthetic antioxidants such as butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT), propyl gallate, ethoxyquin and tertiary-butyl hydro quinone (TBHQ) are used to prolong the storage stability of meat products. Therefore, the importance of search for natural antioxidants, especially of plant origin, has greatly increased in recent years (Jayaprakasha and Jaganmohan Rao, 2000) [11]. Green coffee has been recognized that benefits from consuming green coffee infusions are mainly related to the presence of phenolic compounds, especially chlorogenic acids that have a certain antioxidant activity (Bicchi *et al*., 1995; Naidu *et al*., 2008; Suzuki *et al*., 2002) [3, 18, 24]. Chlorogenic acid, the ester of caffeic acid with quinic acid, is one of the most abundant polyphenols of which green coffee beans, along with certain fruits and vegetables, are the richest dietary sources (Clifford, 1999) [5].

2. Materials and Methods
2.1 Meat and other ingredients
Deboned goat meat was obtained from local market, packed in low density polyethylene bags and kept under refrigeration storage at 4 ± 1 ºC for the subsequent use. Frozen meat was thawed at 4 ± 1 ºC for 24 hrs before use and cut into small pieces before grinding. Refined salt (Tata Chemicals Ltd., Mumbai), refined wheat flour, spice mix ingredients, flaxseed powder, skim milk powder (Anikspray, Nutrica) and green coffee were procured from local market of Jaipur. Fine pastes of onion, garlic and ginger in the ratio 3:1:1 were used for preparation of chevon nuggets. Chemicals and media used for analysis of product were procured from standard firms like Sigma, Mark, SRL and Hi-media etc.

2.2 Preparation of Chevon Nuggets

Frozen chevon was partially thawed overnight, cut into small cubes and double minced with meat mincer. Meat emulsion was prepared in a bowl chopper (Hakimi, India). Pre-weighed quantity of minced chevon, salt, sodium tripolyphosphate and sodium nitrite were added and chopped for about 2-3 minutes. It was chopped again for 2 minutes after the addition of ice flakes. Animal fat was slowly incorporated while chopping till it was completely dispersed in the batter. Refined wheat flour, condiment paste, dry spice mix and other ingredients *viz*: skim milk powder, flaxseed powder, sugar, GCE were added. Chopping was continued till uniform dispersion of all the ingredients and desired consistency of the emulsion was achieved. Weighed quantity of emulsion was taken and filled in stainless steel mould. Mould was covered with lid and tied with thread and steam cooked for 34 minutes. Core temperature of cooked blocks was recorded by using probe thermometer that should reach to 73ºC. Chevon meat block obtained was sliced and cut into pieces to get nuggets and stored at -4 ± 1ºC. At 7 days intervals sample were removed for analysis of physico-chemical, microbiological and sensory properties. The analysis was continued for 7, 14, 21 and 28 day in refrigeration storage.

2.3 Analytical Procedure

2.3.1 Extract preparation

The dried seed of grape seed was air-dried in hot air oven at 50ºC for 2 hrs, followed by grinding in grinder (Uno (mx-140), Groupe SEB India pvt. Ltd) and sieving. Extracts from dried powdered seeds were extracted with 70% ethanol in ether extraction assembly. The color of the extracts was dark brown. The extract was collected and concentrated under reduced pressure in a rotary vacuum evaporator (Labconco Corporation, USA) until semi solid consistency was obtained. The semisolid mass was air-dried to obtain solid mass. Powdered substances were reconstituted with the same solvent as used for extraction to make 5% stock solutions (0.5g of dried extract /10 ml) and stored under refrigeration at 4 °C for further use.

2.3.2 Physicoc-hemical Parameters

The determination of TBARS value was based on the procedure of Witte *et al.* (1970) [27] and FFA% value was estimated as per Koniecko (1979) [13].

2.3.3 Microbiological examinations

Total plate count, psychrophilic count, coliform count and yeast and mold count in the samples were determined following the methods described by APHA (1984) [1].

2.3.4 Sensory Evaluation

There were 7 experienced taste panel members consisting of faculty members and postgraduate students of the department and the institute, evaluated the sensory attributes *viz*. appearance, flavor, texture, juiciness and overall acceptability of treatment and control using 9 point hedonic scale (Wichchukita and O'Mahonyc, 2014).

2.4 Statistical Analysis

Data hence obtained through the experiments were analyzed as per Snedecor and Cochran (1994) [23] using Statistical Software Packages (SPSS 16.0).

3. Results and Discussion

3.1 Physico-chemical properties

3.1.1 TBA value

In this study, treatment had significantly lower (P<0.05) TBARS than control products throughout refrigeration storage period (Table 1). The increase in TBARS value indicated formation of secondary lipid oxidation products. Similar results were observed by Dilnawaz *et al.* (2017) [8] on TBA value in restructured mutton blocks treated with green coffee extract. Increased lipid oxidation during storage was also reported for chicken nuggets (Lal *et al*., 1995 and Modi *et al*., 2004) [15, 28]. General increase in TBARS values might be attributed to the lipid oxidation and the production of volatile metabolites. This was in agreement with the findings of Devatkal *et al.* (2011) [7], Chandralekha *et al*. (2012) [4], Gadekar *et al*. (2014) [9], Bhat *et al*. (2016) [2], Kamal *et al*. (2017) [12], Reddy *et al*. (2017) [20] and Rathour *et al*. (2017) [19] who also found a similar increase in TBARS values during storage of different meat products.

3.1.2 Free fatty acid value

Throughout the storage period FFA value of treatment was lower than control. These results might be attributed to the inhibition of enzymatic action to liberate free fatty acids by GCE. Similar results were observed by Dilnawaz *et al.* (2017) [8] on FFA value in restructured mutton blocks treated with green coffee extract. An increase in FFA values in meat products during storage because of lipase activity has been reported by many authors such as Yashoda *et al*. (2004) [28], Modi *et al*. (2004) [28], Bhat *et al*. (2016) [2], Kamal *et al*. (2017) [12], Reddy *et al*. (2017) [20] and Rathour *et al*. (2017) [19].

Table 1: Effect of green coffee extracts incorporation on physico-chemical properties of chevon nuggets during refrigeration storage (Mean ± SE)

Days/Group	0	7	14	21	28	Treatment Mean ± SE
TBARS						
C	0.28 ± 0.01^{g}	0.46 ± 0.02^{f}	0.59 ± 0.01^{d}	0.78 ± 0.02^{b}	0.87 ± 0.02^{b}	0.59 ± 0.00^{A}
T	0.28 ± 0.01^{g}	0.42 ± 0.03^{f}	0.53 ± 0.01^{e}	0.71 ± 0.02^{c}	0.80 ± 0.01^{a}	0.55 ± 0.00^{B}
Days Mean ± SE	0.28 ± 0.00^{T}	0.44 ± 0.00^{S}	0.56 ± 0.00^{R}	0.74 ± 0.00^{Q}	0.83 ± 0.00^{P}	
Free Fatty Acid Value						
C	0.16 ± 0.01^{g}	0.30 ± 0.01^{e}	0.37 ± 0.01^{d}	0.41 ± 0.02^{c}	0.56 ± 0.02^{a}	0.36 ± 0.00^{A}
T	0.16 ± 0.01^{g}	0.25 ± 0.03^{f}	0.32 ± 0.01^{de}	0.36 ± 0.02^{d}	0.49 ± 0.02^{b}	0.32 ± 0.00^{B}
Days Mean ± SE	0.16 ± 0.01^{T}	0.28 ± 0.01^{S}	0.35 ± 0.01^{R}	0.39 ± 0.01^{Q}	0.53 ± 0.01^{P}	

For each trait, means with different superscript within each column and each row differed highly significantly (P<0.01), significantly (P<0.05) C=control, T= green coffee extract n=6 (for each treatment)

3.2 Microbiological properties

Addition of GCE significantly (P<0.05) influenced the total plate count (TPC) of chevon nuggets during storage. At the end of storage period mean of the treatment (2.74 log cfu/g) have significantly lower TPC than the control (2.90 log cfu/g) (Table 2). Throughout the storage period, TPC of treatment was lower than control. Similar results were observed by Dilnawaz *et al.* (2017) [8] on TPC in restructured mutton blocks treated with green coffee extract. Similar increase in TPC during storage were observed by Devatkal *et al*. (2014), Bhat *et al*. (2016) [2], Kamal *et al*. (2017) [12] and Rathour *et al*. (2017) [19] in ground meat nuggets, chevon nuggets, fortified chevon nuggets and chevon rolls respectively.

The psychrophilic count were not detected on zero day in both treatment and control but they appeared 7th day and to be significantly increase throuhout the storage period. At the end of storage period mean of the treatment (1.88 log cfu/g) has significantly lower psychrophilic count than the control (2.03 log cfu/g) (Table 2). The results of the present investigation was in agreement with findings reported by Reddy *et al.* (2013) and Kaur *et al*. (2015) who observed a reduction in psychrophilic count in restructured mutton slices and chicken nuggets respectively with grape seed extract during storage. Similar results were observed by Dilnawaz *et al.* (2017) [8] on psychrophilic count in restructured mutton blocks treated with green coffee extract. Similar findings were observed by Kumar and Shrama (2004) [14], Thomas *et al*. (2006), Gadekar *et al*. (2014) [9], Bhat *et al*. (2016) [2] and Rathour *et al*. (2017) [19] in different meat products. Coliform were not detected in the treatment as well as control during storage period.

Yeast and molds were not detected till 21 day during refrigeration storage period in both control and antioxidant extract treated chevon nuggets, but they appeared on the 28th day of storage in both control and treatment. The significant effect of natural antioxidants treatment on the yeast and mold count of the chevon nuggets. At the end of storage period treatment (0.294 log cfu/g) have lower yeast & mold than the control (0.343 log cfu/g) (Table 2). Similar results were observed by Dilnawaz *et al.* (2017) [8] in restructured mutton blocks treated with green coffee extract**.**

Table 2: Effect of green coffee extracts incorporation on Microbiological properties of chevon nuggets during refrigeration storage (Mean ± SE)

Days/Group	0	7	14	21	28	Treatment Mean ± SE
Total plate count						
C	2.21 ± 0.03^{i}	2.53 ± 0.01^{g}	2.81 ± 0.03^{e}	3.17 ± 0.02^{c}	3.76 ± 0.02^{a}	2.90 ± 0.01^{A}
T	2.21 ± 0.03^{i}	2.39 ± 0.02^{h}	2.68 ± 0.03^{f}	2.96 ± 0.04^{d}	3.47 ± 0.03^{b}	2.74 ± 0.01^{B}
Days Mean ± SE	2.21 ± 0.01^{T}	2.46 ± 0.01^{S}	2.75 ± 0.01^{R}	3.07 ± 0.01^{Q}	3.62 ± 0.01^{P}	
Psychrophilic count						
C	ND	1.96 ± 0.02^{d}	2.44 ± 0.03^{c}	2.74 ± 0.03^{b}	3.02 ± 0.12^{a}	
T	ND	1.74 ± 0.02^{e}	2.40 ± 0.13^{c}	2.42 ± 0.03^{c}	2.84 ± 0.03a^{b}	
Days Mean ± SE	0.00 ± 0.00	1.85 ± 0.03^{S}	2.42 ± 0.03^{R}	2.58 ± 0.03^{Q}	2.93 ± 0.03^{P}	
Total Yeast and Mold count						
C	ND	ND	ND	ND	1.72 ± 0.09^{a}	
T_1	ND	ND	ND	ND	1.47 ± 0.06^{b}	
Days Mean ± SE	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	1.59 ± 0.01	

For each trait, means with different superscript within each column and each row differed highly significantly (P<0.01), significantly (P<0.05) C=control, T= green coffee extract n=6 (for each treatment)

3.3 Sensory characteristics

The flavor score of chevon nuggets during frefrigeration storage was significantly (P<0.05) affected by both GCE and storage period (Table 3). The chevon nuggets treated with GCE showed significantly (P<0.05) higher flavor score than control. A decrease in texture scores of the products was expected because of proteolytic and lipolytic changes during storage. With increase in storage period, decrease in juiciness scores was noticed for control and treatment. Similar results were observed by Dilnawaz *et al.* (2017) [8] in restructured mutton blocks treated with green coffee extract. A decrease in flavour scores during storage was also reported by Kumar and Sharma (2004) [14], Thomas *et al*. (2006), Das *et al*. (2008) [6] and Chandralekha *et al*. (2012) [4] in different meat products. During entire storage, control products were observed with significant decrease (P<0.05) in overall acceptability scores at each interval of storage period. Control product had significantly lower (P<0.05) scores than treatment products throughout the storage period (Table 3).

During the storage period consistent decrease in overall acceptability scores of all treatments and control was observed. The decrease in overall acceptability could be due to increase in lipid oxidation and degradation of proteins in chevon nuggets over the period of storage. Similar results were observed by Dilnawaz *et al.* (2017) [8] in restructured mutton blocks treated with green coffee extract. The decrease in overall acceptability scores of the products during storage has been reported by various authors such as Bhat *et al.* (2016) [2], Reddy *et al*. (2017) [20] and Rathour *et al*. (2017) [19] in different meat products.

Table 3: Effect of green coffee extracts incorporation on sensory attributes of chevon nuggets during refrigeration storage (Mean ± SE)

Days/Group	0	7	14	21	28	Treatment Mean ± SE
Flavor						
C	6.98 ± 0.06^{c}	6.70 ± 0.02^{d}	6.26 ± 0.02^{e}	5.91 ± 0.03^{f}	5.36 ± 0.02^{h}	6.24 ± 0.01^{B}
T_1	7.35 ± 0.02^{a}	7.08 ± 0.02^{b}	6.76 ± 0.03^{d}	6.18 ± 0.04^{e}	5.60 ± 0.02^{g}	6.59 ± 0.01^{A}
Days Mean ± SE	7.16 ± 0.01^{P}	6.89 ± 0.01^{Q}	6.51 ± 0.01^{R}	6.05 ± 0.01^{S}	5.48 ± 0.01^{T}	
Overall acceptability						
C	6.70 ± 0.03^{b}	6.45 ± 0.04^{c}	6.16 ± 0.03^{d}	5.51 ± 0.04^{f}	5.15 ± 0.05^{g}	5.99 ± 0.02^{B}
T_1	7.00 ± 0.05^{a}	6.76 ± 0.04^{b}	6.45 ± 0.04^{c}	5.98 ± 0.03^{e}	5.63 ± 0.03^{f}	6.36 ± 0.02^{A}
Days Mean ± SE	6.85 ± 0.02^{P}	6.60 ± 0.02^{Q}	6.30 ± 0.02^{R}	5.75 ± 0.02^{S}	5.39 ± 0.02^{T}	

For each trait, means with different superscript within each column and each row differed highly significantly ($P<0.01$), significantly ($P<0.05$) C=control, T= green coffee extract n=6 (for each treatment)

4. Conclusions

The results clearly demonstrate the antioxidant effect of GCE in chevon nuggets during refrigeration storage. The extract effectively improved physic-chemical, microbiological quality and had superior sensory score than control. Thus, green coffee could be successfully used to extend the shelf life of refrigeration meat products.

5. References

1. APHA. Compendium of methods for microbiological examination of foods, 2nd ed. (ed. M.L. Speck) Am. Pub. Health Assoc., Washington, D.C, 1984.
2. Bhat AA, Kumar A, Dua S. Storage quality and oxidative stability attributes of almond (*Prunus dulcis*) fortified chevon nuggets. Journal of Animal Research. 2016;6(4):747-753.
3. Bicchi CP, Binello AE, Pellegrino GM, Vanni AC. Characterization of green and roasted coffees through the chlorogenic acid fraction by HPLC-UV and principal component analysis. Journal of Agricultural and Food Chemistry 1995;43(6):1549-1555.
4. Chandralekha S, Babu AJ, Moorthy PRS, Karthikeyan B. Studies on the effect of pomegranate rind powder extract as natural antioxidant in chicken meat balls during refrigerated storage. Journal of Advance Veterinary Research. 2012;2:107-112.
5. Clifford MN. Chlorogenic acids and other cinnamates-nature, occurrence and dietary burden. Journal of the Science of Food and Agriculture. 1999;79(3):362-372.
6. Das AK, Anjaneyulu ASR, Gadekar YP, Singh RP, Pragati H. Effect of full-fat soy paste and textured soy granules on quality and shelf-life of goat meat nuggets in frozen storage. Meat Science. 2008;80(3):607-614.
7. Devetkal SK, Narsaiah K, Borah A. Anti-oxidant effect of extracts of kinnow rind, pomegranate rind and seed powders in cooked goat meat patties. Meat Science. 2011;85:155-159.
8. Dilnawaz HM, Kumar S, Bhat ZF. Effect of green coffee bean extract on the lipid oxidative stability and storage quality of restructured mutton blocks containing colocasia esculenta, a novel binding agent. Agricultural Research 2017;6(4):443-454.
9. Gadekar YP, Sharma BD, Shinde AK, Verma AK, Mendiratta SK. Effect of natural antioxidants on the quality of cured, restructured goat meat product during refrigerated storage (4 ± 1 ºC). Small Ruminant Research. 2014;119(1):72-80.
10. Igene JO, Pearson AM. Role of phospholipids and triglycerides in warmed-over flavor development in meat model systems. Journal of Food Science. 1979;44(5):1285-1290.
11. Jayaprakasha GK, Jaganmohan RL. Phenolic constituents from lichen *parmotrema stuppeum* (Nyl.) hale and their antioxidant activity. Zeitschrift fur Naturforschung. 2000;55:1018-1022.
12. Kamal SB, Kumar A, Tanwar T. Physico-chemical, proximate, sensory and storage quality attributes analysis of *Papaver somniferum* (poppy) fortified chevon nuggets. Journal of Applied and Natural Science. 2017;9(1):114-120.
13. Konieko EK. In: Handbook for meat chemists. Chap.6, Avery Publishing Group Inc., Wayne, New Jersy, USA, 1979, 68-69.
14. Kumar M, Sharma BD. The storage stability and textural physico-chemical and sensory quality of low fat ground pork patties with carrageenan as fat replacer. International Journal of Food Science and Technology. 2004;39(1):31-42.
15. Lal SM, Gray JJ, Booten AM, Cracle RI, Gill J. Assessment of off-flavour development in restructured chicken nuggets using hexanal and TBARS measurements and sensory evaluation. Journal of Food Science and Agriculture. 1995;67:447-452.
16. Maillard MN, Soum MH, Boivin P, Berset C. Antioxidant activity of barley and malt: relationship with phenolic content. Food Science and Technology. 1996;29(3):238-244.
17. Modi VK, Sachindra NM, Nagegowda P, Mahendrakar NS, Narasimha RD. Quality changes during the storage of dehydrated chicken kebab mix. Journal of Food Science and Technology. 2007;42:827-835.
18. Naidu MM, Sulochanamma G, Sampathu SR, Srinivas P. Studies on extraction and antioxidant potential of green coffee. Food Chemistry. 2008;107(1):377-384.
19. Rathour M, Malav OP, Kumar P, Chatli MK, Mehta N. Storage stability of chevon rolls incorporated with ethanolic extracts of aloe vera and cinnamon bark at refrigeration temperature (4 ± 1 °C). Journal of Animal Research. 2017;**7**(1):183pp.
20. Reddy DM, Babu AJ, Rao BE, Moorthy PRS, Vani S. Studies on the comparative effect of rosemary, green tea extracts and butylated hydroxy anisole on the keeping quality of chicken meat sausages during refregeration storage. International Journal of Current Microbiology and Applied Sciences. 2017;6(3):2144-2151.
21. Sato K, Hegarty GR. Warmed-over flavor in cooked meats. Journal of Food Science. 1971;36(7):1098-1102.
22. Shahidi F, Janitha PK, Wanasundara PD. Phenolic antioxidants. Critical Reviews in Food Science and Nutrition. 1992;32(1):67-103.
23. Snedecor GW, Cochran WG. Statistical methods, First

East West Press Edition, New Delhi, 1994.
24. Suzuki A, Kagawa D, Ochiai R, Tokimitsu I, Saito I. Green coffee bean extract and its metabolites have a hypotensive effect in spontaneously hypertensive rats. Journal of Hypertension Research. 2002;25(1):99-107.
25. Thomas R, Anjaneyulu AS, Kondaiah N. Quality of hurdle treated pork sausages during refrigerated (4 ± 1^0C) storage. Journal of Food Science and Technology. 2010;47(3):266-272.
26. Wichchukit S, O'Mahony MA. Transfer of technology from engineering: use of ROC curves from signal detection theory to investigate information processing in the brain during sensory difference testing. Journal of Food Science. 2010;75:183-193.
27. Witte VC, Krouze GF, Bailey ME. A new extraction method for determining 2- thio barbitutic acid values of pork and beef during storage. Journal of Food Science. 1970;35:582.
28. Yashoda KP, Modi VK, Mahendrakar NS, Sachidra NM, Narasimha Rao D. Quality characteristics of fried broiler chicken prepared by two processing methods. Food Research International. 2004;14:163-173.
29. Younathan MT, Watts BM. Oxidation of tissue lipids in cooked pork. Journal of Food Science. 1960;25(4):538-543.