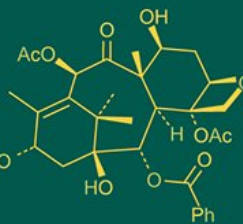
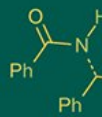


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693

ISSN Online: 2617-4707

NAAS Rating (2026): 5.29

IJABR 2026; 10(9): 452-456

www.biochemjournal.com

Received: 25-07-2026

Accepted: 26-08-2026

Mir Rovida

Division of Livestock Products
Technology, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Sheikh Rafeh Ahmad

Division of Livestock Products
Technology, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Asif Hassan Sofi

Division of Livestock Products
Technology, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Asma Altaf

Division of Livestock Production and
Management, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Aliya Fayaz

Division of Livestock Production and
Management, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Nazir Ahmed Bumla

Division of Livestock Products
Technology, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Corresponding Author:**Mir Rovida**

Division of Livestock Products
Technology, Faculty of Veterinary
Sciences and Animal Husbandry,
Sher-e-Kashmir University of
Agricultural Sciences and Technology
of Kashmir, Shalimar, Srinagar,
Jammu and Kashmir, India

Effect of saffron (*Crocus Sativus L*) petal as preservative during refrigerated storage of mutton nuggets

Mir Rovida, Sheikh Rafeh Ahmad, Asif Hassan Sofi, Asma Altaf, Aliya Fayaz and Nazir Ahmed Bumla

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9f.10020>

Abstract

Lipid oxidation is one of the prominent causes of lowering the storage stability of meat products. Saffron petals, generated as waste during saffron spice harvesting, being a rich yet cheap source of antioxidants, was used as saffron petal powder (SPP) at three levels viz, 1% SPP (T₁), 2% (T₂) and 3% SPP (T₃) to prolong the refrigeration storage life of mutton nuggets. Upon analysis of saffron petal powder treated mutton nuggets, the cooking yield, emulsion stability, ash, moisture and fat showed an increasing trend with increasing SPP levels, while as the pH and protein showed a decreasing trend with increasing SPP levels, although, the sensory score decreased with increasing SPP levels. Based on various parameters, 2 percent level of SPP was found as optimum level for use in mutton nuggets. The nuggets containing this optimum level i.e., 2% SPP along with control (without SPP) were aerobically packaged in low density polyethylene (LDPE) pouches and assessed for storage quality under refrigerated were (4±1°C) conditions for 21 days. Although the lipid oxidation measured as TBARS (mg malonaldehyde/kg) and protein degradation by tyrosine value increased during storage, but for saffron treated products, the increase was significantly slower, indicating preservative effect of saffron petals. Moreover, the antioxidant potential measured as DPPH-RSA was also significantly better in saffron treated products. Microbiological quality evaluation also revealed that SPP treated mutton nuggets had significantly ($P < 0.05$) lower total plate count, coliform count and yeast and mould count as compared to control; the values being acceptable limits even on day 21st of storage period. Although the sensory scores decreased with storage period for all attributes, but samples were acceptable on all days of storage. It was concluded that saffron petals act as natural preservatives during refrigerated storage of mutton nuggets.

Key words: antioxidants, saffron petal powder, shelf life, mutton nuggets, preservative

Introduction

The presence of high quality nutrients especially the presence of essential amino acids and fatty acids make meat products an indispensable part of human diet (Dominguez *et al.*, 2019). Meat products as an exceptional source of premium quality proteins with high biological value, is valued by developing various comminuted value-added meat products (Madane *et al.*, 2019) [19]. However, the comminution of meat by mincing and chopping increase the tendency of pigment and lipid oxidation. This lipid oxidation along with microbial growth are responsible for limiting the shelf-life and consumer acceptance by causing rancidity that affects flavor, color, and even nutrient value of meat products (Ahmed *et al.*, 2016; Papuc *et al.*, 2017; Domínguez *et al.*; 2019 Rahman *et al.*; 2021) [2, 12, 20, 21]. To prevent this oxidation problem in meat products, researches were using antioxidants from so many years. Synthetic antioxidants like Butylated hydroxyanisole (BHA) and Butylated hydroxytoluene (BHT) can generate health disease and carcinogenic if consumed frequently (Lishianawati *et al.*, 2021) [18]. Thus, alternative antioxidants derived from safe natural ingredients are being advocated now a day for use in meat products.

Kashmir is known to produce world's best saffron. During the harvesting of saffron, the petals are generally thrown away as waste. However, these petals are rich in biologically active compounds like phenolics, flavonoides and anthocyanin; hence can be exploited as functional ingredients in different meat products especially for their antioxidant potential

(Hadizadeh *et al.*, 2003) [13], thereby developing novel meat products with improved shelf life, quality and enhanced health benefits. Although enough literature is available regarding the use of natural antioxidants such as rosemary, sea buckthorn, sage, oregano etc. in different meat products, but there was no data available with this regards to the use of saffron petals in mutton nuggets. Therefore, the current investigation was carried out with an intention to explore saffron petals as a potential natural antioxidant source during refrigerated storage of mutton nuggets.

Material and Methods

Procurement of materials for the preparation of mutton nuggets

Mutton was procured from local market of Shuhama, Kashmir and deboned manually. The lean meat obtained after deboning and trimming the fat manually was packed in low density polyethylene (LDPE) pouches (50-100) micron and stored at standard freezing temperature ($-18 \pm 2^{\circ}\text{C}$) until used. Condiment paste used contained fresh onion, garlic and ginger in the ratio of 3:2:1. The spice mix formula was standardized in the laboratory. Saffron petals were dried in an oven at $50-60^{\circ}\text{C}$ (overnight) to a moisture content of less than 8% followed by grinding to form saffron petal powder (SPP) and stored in air tight container for further use. SPP was incorporated in mutton nuggets at three different levels replacing lean meat in the formulation (Table-1).

Preparation of mutton nuggets

Thawed mutton was cut into pieces and minced in a mincer (Sirman, Italy) after passing through 8mm plate (2 times) and 4mm plate (once), salt was added into it along with half of chilled water and mixed for 1 minute. Vegetable oil was gradually added and thoroughly mixed for 1 minute followed by addition of whole egg liquid, dry spice mix and condiment paste for 1-2 minutes till proper emulsion was formed. This formulation served as control. Throughout the preparation, the SPP in different levels (1%, 2% and 3%) was added by replacing lean meat from the basic formulation of the product to produce the emulsion containing SPP. The emulsion prepared was then weighed and filled in stainless steel moulds. Moulds were covered with lid and tied with thread and cooked in hot water (90°C) for 35 minutes to an internal temperature of around 80°C . Mutton loaves so obtained were cooled to room temperature and cut into nuggets of approx 1cm^3 size. Samples were evaluated for various quality parameters to select the optimum level of SPP. Mutton nuggets containing optimum level of SPP (2%) along with control were packed aerobically in LDPE pouches and stored at refrigerated temperature ($4 \pm 1^{\circ}\text{C}$) for 21 days. During the refrigerated storage, nuggets were evaluated at an interval of 7 days on 0th, 7th, 14th, and 21th day for physio-chemical, antioxidant, microbiological and sensory parameters.

Table 1: Formulation of nuggets

Ingredients	Percentage (w/w)			
	Control	1% SPP	2% SPP	3% SPP
Lean mutton	78.00	77.00	76.00	75.00
Saffron petal powder (SPP)	0.00	1.00	2.00	3.00
Ice/Chilled water	8.70	8.70	8.70	8.70
Vegetable oil	5.00	5.00	5.00	5.00
Condiments	3.00	3.00	3.00	3.00
Salt	1.50	1.50	1.50	1.50
Whole egg	2.00	2.00	2.00	2.00
Dry spices	1.50	1.50	1.50	1.50
STPP (Sodium Tripolyphosphate)	0.30	0.30	0.30	0.30
Total	100			

Analytical procedures

The emulsion stability was determined as per the method of Anjaneyulu *et al.* (1989) [3]. The pH of mutton nuggets was estimated by using digital pH meter (Model CP 901, Century Instrument Ltd. India). The proximate composition in both treatment sample and control was determined by using standard procedures of AOAC (2000). Tyrosine value was measured by the procedure put forward by Strange *et al.*, (1977) [22], with slight modifications. Thiobarbituric acid reactive substances (TBARS) value of cooked products was determined using standard procedure of Witte *et al.*, (1970) [24]. The DPPH assay was done according to the method of Brand *et al.*, (1995) [10], with some modifications. Total plate count, coliform count and yeast and mould count were determined by methods of APHA (1984). The sensory evaluation of all sample products was performed by a panel of seven semi-trained members consisting of scientists and post-graduate scholars of the Division of Livestock Products Technology based on 8-point hedonic scale, wherein 8 denoted "extremely desirable" and 1 denoted "extremely undesirable" (Keeton *et al.*, 1984) [15]. The data generated was analyzed by analysis of variances using SPSS software and the significance was checked at 5% level of confidence.

Results and Discussion

Optimisation of concentration of SPP

The physico-chemical properties like pH, cooking yield, emulsion stability and moisture content of SPP treated mutton nuggets was non-significantly ($P > 0.05$) affected as compared to control (Table-2). Non-significant ($P > 0.05$) effects on physio-chemical parameters were also seen by various workers in different meat products (Verma *et al.*, (2013) [23], in mutton nuggets with the incorporation of guava powder; Hazra *et al.* (2012) [14], in buffalo meat treated with the crude extracts of *Moringaoleifera* (Lam.) leaves. There was significant ($P < 0.05$) increase of ash content with increase the level of saffron petal powder. Overall, slightly increased ash percentage of SPP treated mutton nuggets might be attributed to higher mineral content of SPP. Fat content SPP treated mutton nuggets was significantly ($P < 0.05$) higher than control. Protein content of SPP treated mutton nuggets was significantly ($P < 0.05$) lower than control. Similar type of results were reported by Bhat *et al.* (2014) [6], in chicken nuggets treated with *Aloe-vera* pulp.

Table 2: Effect of saffron petal powder on pH, cooking yield, emulsion stability and proximate composition of mutton nuggets (Mean $\pm$ SE)

Parameters	Treatments			
	Control (C)	1%SPP (T ₁)	2%SPP (T ₂)	3%SPP (T ₃)
Product pH	6.35 ^a $\pm$ 0.03	6.34 ^a $\pm$ 0.02	6.33 ^a $\pm$ 0.03	6.33 ^a $\pm$ 0.01
Cooking yield (%)	91.39 ^a $\pm$ 0.89	92.80 ^a $\pm$ 0.87	92.62 ^a $\pm$ 1.32	91.82 ^a $\pm$ 0.90
Emulsion stability (%)	95.48 ^a $\pm$ 0.88	96.12 ^a $\pm$ 0.58	95.78 ^a $\pm$ 0.60	97.21 ^a $\pm$ 0.35
Moisture (%)	61.73 ^a $\pm$ 0.55	61.50 ^a $\pm$ 0.43	61.99 ^a $\pm$ 0.27	62.42 ^a $\pm$ 0.52
Ash (%)	2.68 ^a $\pm$ 0.06	2.82 ^b $\pm$ 0.05	3.01 ^c $\pm$ 0.01	3.12 ^d $\pm$ 0.02
Protein (%)	22.52 ^b $\pm$ 0.01	22.47 ^{ab} $\pm$ 0.02	22.43 ^a $\pm$ 0.02	22.41 ^a $\pm$ 0.03
Fat (%)	7.10 ^a $\pm$ 0.00	7.12 ^a $\pm$ 0.01	7.19 ^b $\pm$ 0.02	7.23 ^b $\pm$ 0.01

Row-wise group means with different superscript differ significantly ($P < 0.05$)

* N = 6

The sensory evaluation revealed that upto 2% addition of SPP, the product remained acceptable for all parameters included overall acceptability (Table-3). However, the panelists rejected the product containing 3% level of SPP. Based on the physico-chemical properties and sensory evaluation of the products, 2% of SPP was selected as

optimum level for use as antioxidant source in mutton nuggets. Therefore, the 2% SPP treated product along with control were stored in low density polyethylene (LDPE) pouches and kept at refrigerated temperature for a period of 21 days to ascertain their storage stability.

Table 3: Sensory attributes of mutton nuggets (Mean $\pm$ SE).

Sensory attributes	Treatments			
	Control (C)	1%SPP (T ₁)	2%SPP (T ₂)	3%SPP (T ₃)
Appearance	7.57 ^c $\pm$ 0.15	7.14 ^b $\pm$ 0.13	7.11 ^b $\pm$ 0.11	6.18 ^a $\pm$ 0.13
Flavour	7.41 ^b $\pm$ 0.18	7.33 ^b $\pm$ 0.14	7.24 ^b $\pm$ 0.14	6.51 ^a $\pm$ 0.14
Texture	7.24 ^a $\pm$ 0.15	7.05 ^a $\pm$ 0.16	7.00 ^a $\pm$ 0.14	6.86 ^a $\pm$ 0.10
Juiciness	7.19 ^a $\pm$ 0.13	7.14 ^a $\pm$ 0.10	7.05 ^a $\pm$ 0.11	6.95 ^a $\pm$ 0.11
Mouth coating	7.48 ^b $\pm$ 0.13	7.42 ^b $\pm$ 0.11	7.38 ^b $\pm$ 0.13	7.09 ^a $\pm$ 0.17
Saltiness	7.43 ^a $\pm$ 0.13	7.29 ^a $\pm$ 0.11	7.19 ^a $\pm$ 0.10	7.14 ^a $\pm$ 0.12
Overall acceptability	7.29 ^b $\pm$ 0.12	7.22 ^b $\pm$ 0.13	7.18 ^b $\pm$ 0.09	6.95 ^a $\pm$ 0.19

Row-wise group means with different superscript differ significantly ($P < 0.05$)

* 8-point descriptive scale (8 = extremely desirable, 1 = extremely undesirable)

**N = 21

Storage studies

During storage, an overall increase in pH of products could be due to production of basic amines from protein breakdown by micro-organisms. The loss of moisture might be due to degradation of proteins responsible for water holding (Das *et al.* 2008) [11]. Ahmad (2014) [1], found similar trend for moisture in aerobically packaged restructured buffalo meat fillets stored at refrigeration temperature. Significantly lower ($P < 0.05$) TBARS and tyrosine values for treatment products could be due to the presence of phenolic compounds in SPP. Kumar and

Tanwar (2011) [16], reported that chicken nuggets containing clove powder (optimized product) maintained significantly ($P < 0.05$) lower TBA values throughout the storage period. DPPH radical scavenging activity (DPPH-RSA) values of SPP treated mutton nuggets were significantly ($P < 0.05$) higher than control. The significantly ($P < 0.05$) higher DPPH-RSA value might be due to the addition of antioxidant rich SPP. These results (increased DPPH-RSA and reduced TBARS and tyrosine values) indicated that saffron petal powder is an excellent natural antioxidant source.

Table 4: Effect of refrigerated storage on physico-chemical and antioxidant parameters of mutton (Mean $\pm$ SE)

Treatments	Storage period (days)			
	0	7	14	21
pH				
Control	6.16 ^{aA} $\pm$ 0.01	6.19 ^{bAB} $\pm$ 0.00	6.23 ^{bB} $\pm$ 0.01	6.33 ^{bC} $\pm$ 0.02
SPP (2%)	6.14 ^{aA} $\pm$ 0.01	6.17 ^{aA} $\pm$ 0.01	6.21 ^{aB} $\pm$ 0.01	6.31 ^{aC} $\pm$ 0.02
Moisture (%)				
Control	61.15 ^{aC} $\pm$ 0.61	60.19 ^{aB} $\pm$ 0.06	59.76 ^{aB} $\pm$ 0.25	59.03 ^{aA} $\pm$ 0.39
SPP (2%)	62.40 ^{bC} $\pm$ 0.13	61.18 ^{bB} $\pm$ 0.10	60.69 ^{bB} $\pm$ 0.24	59.44 ^{aA} $\pm$ 0.60
TBARS				
Control	0.16 ^{bA} $\pm$ 0.01	0.28 ^{bB} $\pm$ 0.01	0.38 ^{bC} $\pm$ 0.02	0.50 ^{bD} $\pm$ 0.01
SPP (2%)	0.14 ^{aA} $\pm$ 0.01	0.18 ^{aB} $\pm$ 0.01	0.21 ^{aC} $\pm$ 0.01	0.31 ^{aD} $\pm$ 0.01
TYROSINE				
Control	0.52 ^{bA} $\pm$ 0.01	0.79 ^{aB} $\pm$ 0.04	1.01 ^{aC} $\pm$ 0.04	1.37 ^{bD} $\pm$ 0.01
SPP (2%)	0.48 ^{aA} $\pm$ 0.01	0.76 ^{aB} $\pm$ 0.05	1.04 ^{aC} $\pm$ 0.05	1.32 ^{aD} $\pm$ 0.01
DPPH-RSA				
Control	15.29 ^{aD} $\pm$ 0.77	11.42 ^{aC} $\pm$ 0.48	8.50 ^{aB} $\pm$ 0.38	2.61 ^{aA} $\pm$ 0.26
SPP (2%)	80.37 ^{bD} $\pm$ 0.35	76.58 ^{bC} $\pm$ 0.57	66.72 ^{bB} $\pm$ 1.16	60.67 ^{bA} $\pm$ 0.35

Mean $\pm$ SE with lower case letter column-wise and upper case letter row-wise with different superscript differ significantly ($P < 0.05$)

* N = 6

During storage, an overall increase in microbial counts (TPC, CC and YMC) were observed, however a comparatively slow increase in SPP treated mutton nuggets might be attributed to the possible antimicrobial activity of the SPP. Similar observation was reported by Ahmad (2014)

[1]. in buffalo meat fillets, Bhat *et al.* (2013a) [8, 9], in chicken seekh kababs, Bhat *et al.* (2013b) [8, 9], in chicken meat balls; Kumar and Tanwar (2011) [16], in chicken nuggets treated with different natural ingredients. During storage, coliform counts were not detected during initial period upto 7th day and yeast and mould count were not detected up to 14th day of storage. YMC were not detected during early period of storage, which could be due to thorough cooking, good hygiene and absence of post processing contamination.

Table 5: Effect of refrigerated storage on microbiological characteristics (Mean $\pm$ SE)

Treatments	STORAGE PERIODS (days)			
	0	7	14	21
Total plate count (logcfu/g)				
Control	0.93 ^{bA} $\pm$ 0.16	2.15 ^{bb} $\pm$ 0.06	2.97 ^{aC} $\pm$ 0.01	3.59 ^{aD} $\pm$ 0.09
SPP (2%)	0.79 ^{aA} $\pm$ 0.19	1.92 ^{aB} $\pm$ 0.05	2.82 ^{aC} $\pm$ 0.03	3.42 ^{aD} $\pm$ 0.12
Coliform count (logcfu/g)				
Control	N.D	N.D	0.34 ^{bA} $\pm$ 0.06	0.85 ^{bB} $\pm$ 0.02
SPP (2%)	N.D	N.D	0.21 ^{aA} $\pm$ 0.03	0.72 ^{aB} $\pm$ 0.01
Yeast and mould count (logcfu/g)				
Control	N.D	N.D	N.D	1.00 ^b $\pm$ 0.03
SPP (2%)	N.D	N.D	N.D	0.56 ^a $\pm$ 0.05

Mean $\pm$ SE with lower case letter column-wise and upper case letter row-wise with different superscript differ significantly ($P < 0.05$)* N = 6 The sensory attributes were significantly affected during 21 days of refrigerated storage showing a descending trend ($P < 0.05$) with storage. The decrease in appearance scores could be due to surface dehydration in aerobic packaging and some pigment and lipid oxidation resulting in metmyoglobin accumulation and non-enzymatic browning. A gradual decline in flavor might be due to the expected loss of volatile flavor components from spices and condiments on storage of meat products.

The decreasing trend in juiciness scores in both enriched products and control nuggets throughout the storage period could be because of some loss of moisture from the products. The overall acceptability scores decreased significantly ($P < 0.05$) as the storage progressed. This decrease might be reflective of the decline in scores of flavor, juiciness and texture. Similar observations were also reported by Bhat *et al.* (2013a, 2013b) [8, 9], Bhat and Pathak (2009) and Kumar and Sharma (2004) [17]. The products were however, acceptable even on 21st day of storage.

Table 6: Effect of refrigerated storage on sensory attributes (Mean $\pm$ SE)

Treatments	STORAGE PERIODS (days)			
	0	7	14	21
APPEARANCE				
Control	7.76 ^{bC} $\pm$ 0.95	7.52 ^{bC} $\pm$ 0.11	6.95 ^{bB} $\pm$ 0.11	6.49 ^{bA} $\pm$ 0.11
SPP (2%)	6.52 ^{aC} $\pm$ 0.11	6.24 ^{aC} $\pm$ 0.15	5.67 ^{aB} $\pm$ 0.12	5.09 ^{aA} $\pm$ 0.17
FLAVOUR				
Control	7.67 ^{bC} $\pm$ 0.10	7.28 ^{bC} $\pm$ 0.14	6.52 ^{bB} $\pm$ 0.16	5.86 ^{bA} $\pm$ 0.19
SPP (2%)	6.71 ^{aC} $\pm$ 0.10	6.19 ^{aB} $\pm$ 0.15	5.80 ^{aB} $\pm$ 0.15	5.14 ^{aA} $\pm$ 0.14
TEXTURE				
Control	7.57 ^{bD} $\pm$ 0.11	7.09 ^{bC} $\pm$ 0.12	6.48 ^{bB} $\pm$ 0.13	5.62 ^{aA} $\pm$ 0.11
SPP (2%)	7.05 ^{aD} $\pm$ 0.11	6.43 ^{aC} $\pm$ 0.16	5.95 ^{aB} $\pm$ 0.16	5.24 ^{aA} $\pm$ 0.15
JUICINESS				
Control	7.71 ^{bB} $\pm$ 0.10	7.43 ^{bB} $\pm$ 0.11	6.71 ^{bA} $\pm$ 0.10	6.43 ^{bA} $\pm$ 0.11
SPP (2%)	6.95 ^{aD} $\pm$ 0.08	6.57 ^{aC} $\pm$ 0.11	5.90 ^{aB} $\pm$ 0.14	5.38 ^{aA} $\pm$ 0.13
MOUTH COATING				
Control	7.81 ^{bC} $\pm$ 0.88	7.48 ^{bC} $\pm$ 0.11	7.00 ^{bB} $\pm$ 0.12	6.33 ^{bA} $\pm$ 0.16
SPP (2%)	7.14 ^{aC} $\pm$ 0.14	6.38 ^{aB} $\pm$ 0.13	6.00 ^{aB} $\pm$ 0.15	5.33 ^{aA} $\pm$ 0.12
SALTINESS				
Control	7.86 ^{bD} $\pm$ 0.08	6.71 ^{bC} $\pm$ 0.10	6.81 ^{bB} $\pm$ 0.11	6.28 ^{bA} $\pm$ 0.16
SPP (2%)	7.28 ^{aC} $\pm$ 0.14	6.90 ^{aC} $\pm$ 0.14	6.19 ^{aB} $\pm$ 0.16	5.52 ^{aA} $\pm$ 0.13
OVERALL ACCEPTABILITY				
Control	7.81 ^{bC} $\pm$ 0.09	7.48 ^{bC} $\pm$ 0.11	6.90 ^{bB} $\pm$ 0.12	6.23 ^{bA} $\pm$ 0.15
SPP (2%)	6.67 ^{aC} $\pm$ 0.12	6.28 ^{aC} $\pm$ 0.16	5.77 ^{aB} $\pm$ 0.12	5.38 ^{aA} $\pm$ 0.13

Conclusion

The outcome of the current investigation pointed out that saffron petal powder is an excellent source of antioxidants as was confirmed by the results during refrigerated storage of mutton nuggets. The saffron petals also showed antimicrobial effects. It was thus concluded that the waste

product i.e., saffron petals, if exploited properly can add value and storage stability to meat products.

Acknowledgement

The authors are thankful to the Dean, faculty of veterinary

sciences and animal husbandry SKUAST Kashmir for providing the necessary facilities.

Reference

- Ahmad SR. Development of functional restructured buffalo meat fillets [dissertation]. Izatnagar, India: Indian Veterinary Research Institute, Deemed University; 2014.
- Ahmed M, Pickova J, Ahmad T, Liaquat M, Farid A, Jahangir M. Oxidation of lipids in foods. *Sarhad J Agric*. 2016;32(3):230-238.
- Anjaneyulu ASR, Sharma N, Kondaiah N. Evaluation of salt, polyphosphates and their blends at different levels on physico-chemical properties of buffalo meat and patties. *Meat Sci*. 1989; 25:293-306.
- Association of Official Analytical Chemists. Official methods of analysis. 16th ed. Washington, DC: Association of Official Analytical Chemists; 2000.
- American Public Health Association. Compendium of methods for the microbiological examination of foods. 2nd ed. Speck ML, editor. Washington, DC: American Public Health Association; 1984.
- Bhat ZF, Kumar S. Effect of Aloe vera on the lipid stability and storage quality of chicken nuggets. *Nutr Food Sci*. 2014; 45:54-67.
- Bhat ZF, Pathak V. Effect of black bean (*Vigna mungo*) on the quality characteristics of oven-roasted chicken seekh kababs. *J Stored Prod Postharvest Res*. 2009;2:15-23.
- Bhat ZF, Kumar P, Kumar S. Effect of skin, enrobing and refrigerated storage on the quality characteristics of chicken meat balls. *J Food Sci Technol*. 2013; 50:890-899.
- Bhat ZF, Pathak V, Bhat HF. Effect of refrigerated storage on the quality characteristics of microwave cooked chicken seekh kababs extended with different non-meat proteins. *J Food Sci Technol*. 2013; 50:926-933.
- Brand W, Cuvelier ME, Berset C. Use of a free radical method to evaluate antioxidant activity. *Lebensm Wiss Technol*. 1995; 28:25-30.
- Das AK, Rajkumar V, Verma AK, Swarup D. Moringa oleifera leaves extract: a natural antioxidant for retarding lipid peroxidation in cooked goat meat patties. *Int J Food Sci Technol*. 2008; 43:585-591.
- Domínguez R, Pateiro M, Gagaoua M, Barba FJ, Zhang W, Lorenzo JM. A comprehensive review on lipid oxidation in meat and meat products. *Antioxidants*. 2019;8(10):1-31.
- Hadizadeh F, Khalili N, Hosseinzadeh H, Khair-Aldine R. Kaempferol from saffron petals. *Iran J Pharm Res*. 2003; 2:251-252.
- Hazra S, Biswas S, Bhattacharya D, Das SK, Khan A. Quality of cooked ground buffalo meat treated with crude extract of *Moringa oleifera* (Lam.) leaves. *J Food Sci Technol*. 2012; 49:240-245.
- Keeton JT. Effect of fat and NaCl/phosphate levels on the chemical and sensory properties of pork patties. *J Food Sci*. 1984; 48:878-881.
- Kumar D, Tanwar VK. Utilization of clove powder as phytopreservatives for chicken nuggets preparation. *J Stored Prod Postharvest Res*. 2011;2:11-14.
- Kumar RR, Sharma BD. Storage quality and shelf life of aerobically packaged extended chicken patties. *J Vet Public Health*. 2004;2:35-41.
- Lishianawati TU, Yusiati LM, Jamhari. Antioxidant effects of black garlic powder on spent duck meat nugget quality during storage. *Food Sci Technol*. 2021; 42:1-8.
- Madane P, Das AK, Pateiro M, Nanda PK, Bandyopadhyay S, Jagtap P, *et al*. Drumstick (*Moringa oleifera*) flower as an antioxidant dietary fibre in chicken meat nuggets. *Foods*. 2019;8(8):307.
- Papuc C, Goran GV, Predescu CN, Nicorescu V. Mechanisms of oxidative processes in meat and toxicity induced by postprandial degradation products: a review. *Compr Rev Food Sci Food Saf*. 2017;16(1):96-123.
- Rahman MH, Alam MS, Monir MM, Kawsar A. Comprehensive effects of black cumin (*Nigella sativa*) and synthetic antioxidant on sensory and physicochemical quality of beef patties during refrigerant storage. *J Agric Food Res*. 2021; 4:140-145.
- Strange ED, Benedict RC, Smith JL, Swift GE. Evaluation of rapid tests for monitoring alterations in meat quality during storage. *J Food Prot*. 1977; 40:843-847.
- Verma AK, Rajkumar V, Banerjee R, Biswas S, Das AK. Guava (*Psidium guajava* L.) powder as antioxidant dietary fibre in sheep meat nuggets. *Asian-Australas J Anim Sci*. 2013; 26:886-895.
- Witte VC, Krause GF, Bailey MF. A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. *J Food Sci*. 1970;35:582-585.