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Research Paper

Storage Quality of Rista with Rosemary Extract as an Antioxidant

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ABSTRACT

The effect of incorporation of rosemary extract at 0.005% on the quality and storage stability of *Rista* was studied. All the physico-chemical parameters of raw emulsion, cooked product and gravy showed non-significant difference ($p>0.05$) between the treatments. Sensory scores of *Rista* showed non-significant ($p>0.05$) difference. Further, the cooked product was aerobically packaged in LDPE bags and stored at $4+1^{o}$C for a period of 3 weeks during which the product samples were drawn at weekly intervals and evaluated for pH, 2-thiobarbituric acid (TBA) value, microbiological quality and sensory attributes. The results indicated that the pH and TBA value of *Rista* samples increased significantly ($p<0.05$) with the advancement of storage. However, the values even at the end of storage period were well below the reported safe limits and not indicative of any rancidity. The total plate count and coliform count of *Rista* samples increased significantly ($p<0.05$) during storage. The yeasts and moulds were detected only from day 14 of storage and then increased significantly ($p<0.05$) by the end of day 21 of storage. The microbial counts in general remained low and well within permissible limits even at the end of the storage period. The results of sensory evaluation revealed a gradual decrease in the scores of various attributes with the advancement of storage. However, the scores even at the end of storage period remained generally in the range of above six indicating good acceptability of the product.

Keywords : *Meat emulsion, Natural antioxidant, Rancidity, Rista, Rosemary, Shelf-life.*

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INTRODUCTION

is an emulsion type meat product usually prepared from hot boned mutton after manual pounding on a stone slab with the help of a wooden hammer. A considerable amount of animal fat (about 20-30%) is used in the formulation of *Rista* to achieve a stable emulsion and also to impart unique taste and flavor to the product. However, the addition of fat in such amounts makes this product more susceptible to oxidative changes resulting in the development of rancidity and off-flavors and thus an overall decrease in its quality. Thus, there is a need to improve the quality of the product by inhibiting or decreasing this problem. Various plant extracts, separated from natural sources, have proven to possess strong antioxidant activity due to their high content of phenolic compounds and are permitted for use in foods to replace synthetic antioxidants. Among these plant products, rosemary extract is one of the most potent and effective plant product with excellent antioxidant effect and is authorised as a food additive for use in foodstuffs under Directive 95/2/EC of European Commission and assigned E-392 as E-number. The antioxidant activity of rosemary extract has been associated with presence of several phenolic diterpenes (Trindade *et al.* 2010; Bragagnolo *et al.* 2007). Hence, keeping in view the importance of *Rista* and associated risk of lipid oxidation, the present study was undertaken with the objective of studying the effect of rosemary extract on the quality and storage stability of *Rista.*

MATERIALS AND METHODS

Lean mutton and fat obtained from young and tender male lambs in the age group of 6-9 months, was used for the preparation of the product within 2 hours of slaughter. Dry spices (large cardamom, small cardamom, cinnamon, cloves, turmeric and ginger powder), leek (*Allium cepa var. viviparum*), dried Kashmiri red chillies (*Capsicum annum*) extract, garlic paste, common salt and vegetable oil from reputed brands were purchased from the local market and used in product preparation. Rosemary extract supplied by FASIAM Agro Chemicals, Srinagar was used in product formulation. The product was prepared according to the standardized processing schedule and recipe of Samoon (1988) with slight modifications. The general formulation of *Rista* was: Boneless mutton-80%, mutton fat-20%, common salt-2.50%, chilled water/ice flakes-10% and large cardamom seeds-0.20%. This served as control (T_0). For the purpose of experimental requirements of the present study, the formulation was modified to include rosemary extract @ 0.005% which served as Treatment-1 (T_1).

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Meat emulsion was prepared by traditional method of pounding hot boned meat manually on a flat and smooth stone called *Maz- Kaene* ("*Maz*"-meat ; "*Kaene*"- stone) with a wooden hammer called "*Goshpare*" ("*Gosh*"; meat" *Pare*": hammer) along with mutton fat, first individually and then in combination. Common salt and large cardamom seeds were added to it during beating. Periodical sprinkling of chilled water was done. Pounding of meat was continued until the emulsion exhibited a characteristic cohesiveness, binding and fluidy consistency, traditionally called as "*Macchwor*". After addition of the antioxidant, the emulsion was further subjected to pounding to ensure uniform mixing of the antioxidant. The raw emulsion (1000 gm) obtained were then molded in a shape of spherical balls (50gm each) and kept in refrigerator. For preparing gravy, water (2000 gm) was heated in a thick-bottomed stainless steel vessel covered with a lid. Turmeric powder (25 gm) was added to it and boiling continued for 15 minutes. Then, red chilli extract (250 gm), hydrogenated vegetable oil (125 gm), garlic paste (8 gm), large cardamom (2.50 gm), small cardamom (1 gm), cinnamon (3.50 gm), cloves (0.50 gm), dried ginger powder (4 gm) and fried leek paste (50 gm) were added to it. Boiling was continued for 20 minutes until the gravy of desired viscous consistency was obtained. Salt (10 gms) was added towards the end of cooking. The meat balls reshaped and removed from the refrigerator, were transferred to the boiling gravy and cooked for 25 minutes.

Samples were subjected to quality evaluation in terms of physico-chemical and sensory attributes. Moisture, protein, fat and ash content of raw emulsion, cooked product and gravy were estimated by following the method of AOAC (1995). The pH was determined by following the method of Keller *et al.* (1974). The emulsion stability of the raw samples was determined as per the method of Baliga and Madaiah (1970). The cooking yield percent was calculated by dividing the weight of cooked balls with weight of uncooked balls. The product along with its gravy was aerobically packaged in LDPE bags and stored at 4±1°C for a period of 3 weeks during which, the product sample was drawn at weekly intervals and evaluated for physico-chemical parameters, microbiological quality and sensory characteristics. The estimation of TBA value was done by following the method of Witte *et al.* (1970) with slight modifications. The samples of *Rista* were subjected to microbiological analysis for Total Plate Count, Coliform Count and Yeast and Mould Count as per the method described by Maturin and Peeler (2001), Feng *et al.* (2002) and Tournas *et al.* (2001), respectively. Sensory quality was evaluated as per Seman *et al.* (1987) wherein the meat balls in their respective gravies at a temperature of 30-35°C were assessed under incandescent light for their appearance, flavour, juiciness, texture and overall palatability by a group of not less than 8 experienced panel of judges. Water was provided between samples to cleanse the palate. The data obtained from three replications were analyzed by ANOVA. Duncan's Multiple Range test and critical difference were determined at 5% significance level using SPSS-version 17.0.

RESULTS AND DISCUSSION

Non-significant difference ($p>0.05$) was found between the pH of control and rosemary formulated raw emulsions. The cooked product and the gravy also exhibited a similar trend in pH as that of their emulsion (Table 1). Non-significant difference ($p>0.05$) in the pH values of control and rosemary treated samples was reported by Keokamnerd *et al*. (2008) in ground chicken meat and Jatosinska and Wilczak (2009) in beef and pork meat balls. Similarly, non-significant difference ($p>0.05$) between the emulsion stability values of the control and rosemary formulated emulsions was observed. The cooking yield of rosemary formulated *Rista* samples was near to similar ($p>0.05$) to that of the control samples. Non-significant differences ($p>0.05$) were observed between the mean percent moisture values of the T_0 and T_1 raw emulsion, cooked product and the gravy. The percent protein content of the control and rosemary formulated raw emulsions and cooked products did not differ significantly. The control and rosemary formulated raw emulsions for *Rista* did not differ significantly ($p>0.05$) in the fat content. These results fat and ash contents are in tune with the observed changes in moisture and protein contents discussed above. This was expected as the formulations were exactly the same for various treatments under each product except for the addition of antioxidants which would not affect chemical composition of *Rista*. These findings were in agreement with Samoon (1988).

Appearance, juiciness and texture scores for control and rosemary formulated samples ranged in between 6 and 8, and were thus rated as very good to good (Table 2). Better appearance of the rosemary formulated samples might be attributed to more desirable colour, better fat dispersion and better binding leading to a more uniform cross-sectional appearance as compared to the control samples. Similarly, better emulsion stability of the batter offered by the addition of rosemary might have been responsible for the better texture of rosemary formulated *Rista* samples as compared to the control. There was no significant difference ($p>0.05$) among the flavour scores of treated sample and control. Rosemary formulated samples received the lowest flavour scores (6.47).

The lower (Table 1,2 & 3) flavour scores in case of rosemary formulated samples might be because of certain compounds present in rosemary even at low concentrations as reported by Carrillo and Tena (2006). With respect to the overall palatability scores, although the same trend was observed, i.e., palatability scores were higher for Rosemary formulated samples than the control; however, the difference was non-significant.

Table 1: Effect of rosemary extract on the physico-chemical qualities of *Rista*

Parameters	Raw Emulsion		Cooked Product		Rista Gravy	
	T_0	T_1	T_0	T_1	T_0	T_1
pH	5.94±0.01	5.92±0.01	6.24±0.01	6.21±0.01	6.19±0.01	6.15±0.02
Moisture (%)	63.61±0.21	63.36±0.22	62.09±0.15	62.01±0.21	80.36±0.07	80.43±0.17
Protein (%)	16.26±0.11	16.30±0.09	15.11±0.15	15.21±0.13	2.59±0.04	2.45±0.04
Fat (%)	17.11±0.13	17.19±0.04	18.14±0.07	18.22±0.11	11.44±0.08	11.35±0.07
Ash (%)	2.11±0.08	2.13±0.06	2.56±0.10	2.62±0.12	2.86±0.06	2.81±0.06
Emulsion stability (%)	6.98±0.29	6.73±0.11	-	-		
Cooking Yield (%)	-	-	93.02±0.44	93.67±0.34		

Means (±SE) with same superscripts row-wise do not differ significantly (p>0.05) *n = 6/Treatment. T_0 (Control); T_1 (Rosemary extract @ 0.005%)

Table 2: Effect of rosemary extract on the sensory qualites of

Parameters	Treatments	
	T_0	T_1
Appearance	6.73±0.08	6.80±0.10
Flavour	6.67±0.12	6.47±0.11
Juiciness	6.70±0.14	6.77±0.10
Texture	6.53±0.13	6.80±0.11
Mouth coating	6.63±0.12	6.63±0.12
Overall palatability	6.63±0.11	6.77±0.12

n = 30/Treatment. T_0 (Control); T_1 (Rosemary extract @ 0.005%).

The pH gradually increased during storage probably because of accumulation of bacterial metabolites and deamination of proteins (Jay 1996). Jatosinska and Wilczak (2009) also reported a linear increase in pH of Rosemary treated meat samples but the values were lower than control samples, which were in agreement with our findings. TBA values of control were significantly (p<0.05) higher than Rosemary treated samples on day 7 and it increased linearly in both the groups during the storage (Table 3). Love and Pearson (1974) reported that the TBA value of 1.0 and above were generally associated with rancidity problems. However, in the present study the TBA values remained below the threshold value for sensory perception and no 'off' flavour was observed.

The total plate counts of both the treatments of *Rista* samples increased significantly. The overall total plate count of Rosemary formulated *Rista* samples was significantly lower (P<0.05) than that of control. Similar results of the effectiveness of Rosemary against a wide variety of bacteria were reported by Celiktas *et al*. (2007). The total plate count of *Rista* samples ranged from 1.93 to 3.47 log cfu/g. Notwithstanding the significant difference between the treatment counts at various storage intervals, the increase in total plate counts was modest and far below the incipient spoilage level of 7 log cfu/g (Frazier and Westhoff 1988). The mean coliform count of Rosemary formulated *Rista* samples was significantly lower (P<0.05) than that of control. Similar findings were observed by Hac-Szymanczuk *et al*. (2011) who reported lower coliform counts in Rosemary treated pork batters as compared to control samples and attributed the effect to the considerable concentration of 1,8-cyneole and verabenone in the Rosemary preparation. The mean coliform counts for all the treatments of *Rista* samples observed in the present study were well within maximum suggestive limits 2.69 log cfu/g indicated by Goldenberg and Elliot (1973). The yeast and mould counts of Rosemary formulated *Rista* samples was significantly lower (p<0.05) than that of the control. Georgantelis *et al.* (2007) reported that Rosemary extract decreased the growth of yeasts and moulds in pork sausages stored for 20 days at 4°C. Khaddor *et al.* (2006) also observed that Rosemary essential oil decreased the mycelial growth of Penicillium fungus in yeast extract sucrose broth.

Mean sensory scores (Table 3) showed a decreasing trend with increase in storage days. Lalas *et al.* (2007) also reported a significant decrease in the colour scores of both control and Rosemary extract treated Deples and Tarama salad during the course of 35-40 days of refrigerated storage which was in agreement with our study. A gradual decrease in the flavour scores might be due to progressive increase in the lipid oxidation as depicted by increase in the TBA as well as by increase in the microbial load of the products. During refrigerated storage there was a gradual decrease in the juiciness scores from day 0 onwards. Sahoo and Anjaneyulu (1997) also observed decrease in juiciness scores of buffalo nuggets with the advancement of storage. The overall texture scores of Rosemary formulated *Rista* samples was significantly ($P<0.05$) higher than those of the control samples. With increase in storage days, a gradual decrease in the texture scores was observed which might be attributed to the breakdown of fat and protein. Similar trend of decreasing texture scores with the progress of storage was reported by Anjaneyulu (1988) in case of buffalo meat patties and Sahoo and Anjaneyulu (1997) in buffalo meat nuggets. A modest non-significant decrease in the mouth coating scores was observed which might be due to changes brought out in the products by lipid oxidation and protein degradation during the course of storage. The overall palatability scores of the Rosemary formulated *Rista* samples was significantly ($P<0.05$) higher than that of control samples. AbdEl-Hamied *et al.* (2009) also reported a higher mean overall acceptability score of minced meat treated with Rosemary extract as compared to control during refrigerated storage period of 10 days. Similarly, Lalas *et al.* (2007) also observed increased overall acceptability scores of Deples and Tarama salad (traditional Greek foods) treated with Rosemary extract as compared to the control samples for 35-40 days of refrigerated storage which was in agreement with our findings.

CONCLUSION

Rista has a high sensory appeal but is associated with rancidity and decrease in overall storage stability. From the present study, it may be concluded that Rosemary extract at 0.005% level, could be successfully incorporated in *Rista* with no adverse effects on physicochemical and sensory quality of the product. It may be further concluded that the antioxidant has improved oxidative stability and storage quality of the product under refrigerated storage. Thus incorporation of Rosemary extract in the formulation *Rista* can prove a technologically efficient and viable means of quality enhancement during refrigerated storage.

Table 3: Effect of refrigerated storage and rosemary extract on physico-chemical, microbiological and sensory characteristics of *Rista*

Treatments*	Storage period (days)			
	0	7	14	21
		Normal		
T_0	$6.01^{a}\pm0.01$	$6.34^{bB}\pm0.01$	$6.42^{cB}\pm0.004$	$6.58^{dB}\pm0.02$
T_1	$5.98^{a}\pm0.004$	$6.16^{bA}\pm0.01$	$6.21^{cA}\pm0.01$	$6.30^{dA}\pm0.01$
		TBA (mg malonaldehyde/Kg)		
T_0	$0.19^{a}\pm0.001$	$0.39^{bB}\pm0.001$	$0.59^{cB}\pm0.02$	$0.74^{dB}\pm0.01$
T_1	$0.18^{a}\pm0.001$	$0.31^{bA}\pm0.01$	$0.39^{cA}\pm0.003$	$0.58^{dA}\pm0.003$
		Total Plate Count (log10cfu/g)		
T_0	$1.96^{a}\pm0.05$	$2.62^{bB}\pm0.05$	$3.78^{cB}\pm0.08$	$4.86^{dB}\pm0.02$
T_1	$1.93^{a}\pm0.02$	$2.17^{bA}\pm0.02$	$2.94^{cA}\pm0.05$	$3.47^{dA}\pm0.09$
		Coliform Count (log^{10}cfu/g)		
T_0	$1.32^{a}\pm0.03$	$1.67^{bB}\pm0.10$	$2.27^{cB}\pm0.09$	$2.61^{dB}\pm0.05$
T_1	$1.23^{a}\pm0.04$	$1.29^{aA}\pm0.09$	$1.64^{bA}\pm0.08$	$2.00^{cA}\pm0.12$
		Yeast and Mould Count (log^{10}cfu/g)		
T_0	N.D	N.D	$1.98^{aB}\pm0.07$	$2.79^{bB}\pm0.02$
T_1	N.D	N.D	$0.60^{aA}\pm0.27$	$1.15^{bA}\pm0.07$

		Appearance**		
T_0	$7.39^{b}\pm0.11$	$7.11^{b}\pm0.08$	$6.57^{a}\pm0.13$	$6.39^{a}\pm0.13$
T_1	$7.43^{b}\pm0.10$	$7.18^{b}\pm0.07$	$6.75^{a}\pm0.10$	$6.68^{a}\pm0.13$
		Flavour		
T_0	$7.32^{b}\pm0.09$	$7.21^{b}\pm0.11$	$6.25^{aA}\pm0.17$	$6.07^{aA}\pm0.17$
T_1	$7.25^{b}\pm0.12$	$7.14^{b}\pm0.07$	$6.79^{aB}\pm0.16$	$6.50^{aB}\pm0.11$
		Juiciness		
T_0	$7.21^{b}\pm0.11$	$7.04^{b}\pm0.11$	$6.43^{aA}\pm0.14$	$6.32^{aA}\pm0.14$
T_1	$7.25^{b}\pm0.10$	$7.11^{ab}\pm0.08$	$6.96^{abB}\pm0.12$	$6.86^{aB}\pm0.10$
		Texture		
T_0	$7.29^{c}\pm0.10$	$7.00^{c}\pm0.12$	$6.50^{bA}\pm0.17$	$6.14^{aA}\pm0.08$
T_1	$7.29^{c}\pm0.09$	$7.18^{bc}\pm0.10$	$6.93^{abB}\pm0.14$	$6.75^{aB}\pm0.13$
		Mouth Coating		
T_0	$7.29^{b}\pm0.09$	$7.18^{b}\pm0.09$	$7.14^{b}\pm0.12$	$6.75^{a}\pm0.12$
T_1	$7.25^{b}\pm0.11$	$7.21^{b}\pm0.09$	$7.18^{b}\pm0.09$	$6.79^{a}\pm0.11$
		Overall Palatability		
T_0	$7.32^{b}\pm0.12$	$7.00^{b}\pm0.15$	$6.29^{aA}\pm0.18$	$6.18^{aA}\pm0.13$
T_1	$7.29^{b}\pm0.11$	$7.21^{b}\pm0.14$	$6.68^{aB}\pm0.10$	$6.61^{aB}\pm0.12$

Nested Means (± SE) with same lower case superscripts row-wise and upper case superscripts column-wise for each parameter do not differ significantly (P>0.05). Overall Means (± SE) with common upper case superscripts column-wise for each parameter do not differ significantly (P>0.05). *n = 6/Storage interval/Treatment. *T_0 (Control); T_1 (Rosemary extract@ 0.005%). 8-point Descriptive Scale (8=extremely desirable, 1=extremely undesirable). **n = 28/Storage interval/Treatment.

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