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ORIGINAL ARTICLE

Quality evaluation of mutton *Harrisa* during one week refrigerated storage

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Abstract *Harrisa* is a popular indigenous meat based product of Jammu and Kashmir. An attempt was made to standardize the basic formulation and processing conditions for the preparation of the *Harrisa* using mutton meat. The product so developed was packed in low density polyethylene pouches (LDPE) and evaluated for a shelf life of 1 week at refrigeration (4±1°C) temperature for various physico-chemical, microbiological and sensory attributes. The mean values of pH, protein percent, fat percent and ash percent of the product increased significantly ($P<0.05$) whereas the mean moisture percent showed a significantly ($P<0.05$) decreasing trend during refrigerated storage. The mean scores of all the sensory parameters decreased significantly ($P<0.05$) with storage. Total plate count and psychrophilic count increased significantly ($P<0.05$) whereas the coliforms were not detected throughout the period of storage. Thiobarbituric acid reacting substances (TBARS) and free fatty acid (% oleic acid) values also increased significantly ($P<0.05$) with storage period. Although storage resulted in significant decrease in almost all the quality attributes and sensory scores but the changes were within the limits of acceptability. The product was acceptable for a period of one week under refrigerated conditions.

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Introduction

Harrisa is a popular indigenous ready to eat meat based product of the state of Jammu and Kashmir that is very much relished by the people particularly in winter months during early morning hours. It is easy to prepare and could be served to a large number of people in relatively short time and thus it comes under the category of convenience ready to eat meat products. It is usually made from mutton, chevon or beef but particular styles of *Harrisa* could be prepared from other meat animals like chicken, fish etc. It has a pasty consistency and particular spice rich flavour. It is usually sold at "*Harrisa*-corners" or made at home throughout the state using different ingredients and processing conditions. As such there seems to be no standard method of preparation and control over the quality.

Indigenous meat products are unique in their spicy flavour, simplicity and ease of preparation. They have the potential of becoming value added convenience products of good palatability (Bhat et al. 2010). Despite of increasing urbanization and change in lifestyle, the liking for traditional meat products still exist among people (Kandeepan et al. 2010). Moreover, due to rapid development in meat based fast food industry with preference for processed products, the scope for production of traditional meat products has increased immensely, creating a need for developing technologies for manufacturing indigenous products on large commercial scale to meet the demands of growing population (Bhat et al. 2010). The development of suitable technological package for the organized production of indigenous meat products would offer significant

value addition and product diversification for Indian meat industry.

Population growth, urbanization, economic growth and flourishing markets all lead to the increasing demand for meat and animal products (Delgado 2003; Costales et al. 2006). Until 2020, demand for meat and meat products is expected to increase highly in developing countries and slightly in developed counties (Rosegrant et al. 1999; Delgado 2003) which will create markets for meat and animal products (Delgado 2003). However, the unwillingness of the consumer to change dietary habits suggests that there is a great market potential for foods with unchanged sensory attributes (Becker and Kyle 1998). Most people would like to eat a healthier diet without fundamentally changing their eating patterns. Thus there is need for the development of traditional meat products on commercial scales with altered nutritional characteristics but unchanged sensory attributes. However, if traditional meat based products are proposed to be marketed on commercial scales, it becomes imperative that suitable technologies be developed for their production and packaging.

The method of manufacture of *Harrisa* is traditional, primitive and more or less limited and offers a great scope for development. The efforts are needed to be directed towards modernizing the processing parameters on the scientific lines with respect to the raw material use, processing techniques, end product characteristics, preservation and value addition. Further no literature is available regarding the formulation, processing conditions and quality changes of the mutton *Harrisa* during storage. There is an immediate need for scientific standardization and evaluation of the product so that literature will be generated and further research could be conducted on the product (Bhat et al. 2010). In lieu of these facts an initial attempt was made to optimize the basic formulation and processing conditions for the preparation of *Harrisa* using mutton meat and to study its physicochemical, microbiological and sensory properties for a shelf life of 1 week at refrigeration temperature (4±1°C).

Material and methods

Source of meat

The mutton meat from "gluteus, semitendinosus, semimembranosus, gracialis and quadratus femoris" muscles was obtained from adult males within 5 h of their being slaughtered from the local market of Jammu. The separable fat and connective tissue was removed manually removing all tendons and separable connective tissue. The lean meat was packed in LDPE (low density polyethylene) bags and frozen at −20°C until use.

Spice mixture

The spice mix formula used for preparation of the *Harrisa* contained anise (soanf-45%), green cardamom (choti elaichi-6%), black cardamom (badi elaichi-8%), cinnamon (dalchini-21%), clove (loang-2%), red chilli (5%), coriander (dhania-10%), coloured chilli (1%) and black pepper (kali mirch-2%). The spices were purchased from local market. After removal of extraneous matter, all spices were dried in an oven at 50°C for overnight and then ground in grinder to powder. The coarse particles were removed using a sieve (100 mesh) and the fine powdered spices were mixed in required proportion to obtain spice mixture for mutton *Harrisa*. The spice mixture was stored in plastic airtight container for subsequent use.

Methodology of preparation of *Harrisa*

Harrisa is a popular spice rich indigenous meat based product and rice paste along with high levels of condiments and spices are traditionally used for its preparation. Preliminary trials were conducted in the laboratory to standardize the levels of different ingredients in the basic formulation during product development. Different levels of rice paste (4%, 8% and 12%), condiments (5%, 7% and 9%), spice mix (4%, 8% and 12%) and refined oil (9%, 10% and 11%) were tried. On the basis of various sensory parameters, 8% rice paste, 9% condiments, 4% spice mix and 11% refined oil were optimized as best.

Rice in water in the ratio of 1:2 was cooked and converted to a paste form. Condiments were prepared by making a fine paste of onion and garlic in the ratio of 3:1 in a mixer-grinder. The different ingredients used for the preparation of *Harrisa* are rice paste (8%), condiments (9%), spice mixture (4%), salt (2%), refined oil (11%) and mutton meat (66%). For 1 kg of product, 2 kg of water was taken in a pressure cooker i.e. in a proportion of 1:2. Meat, salt and spice mix were added to the water and cooked until a clear paste was obtained i.e. no intact muscle fibers were visible. Subsequently rice paste and condiments were also added and the paste was simmered for 15 min keeping the lid over the pressure cooker. There after refined oil (preheated) was added and the mixture was again simmered (nearly for 15 min) for a time till a product with thick consistency was obtained. The product so developed was aerobically packaged in low density polyethylene (LDPE) pouches and was analyzed at a regular interval of 0, 4 and 7 days during refrigerated storage at 4±1°C for physicochemical, microbiological and sensory parameters.

Analytical procedures

The pH of *Harrisa* soon after its preparation was determined by the method of Keller et al. (1974) with

slight modifications using a digital meter (Systronics Digital pH Meter 803, serial No. 603). Moisture, fat, protein and ash percentage of the product were estimated as per AOAC (1995). Method of Witte et al. (1970) and Koniecko (1979) was used for measuring Thiobarbituric acid reacting substances (TBARS) and free fatty acid values respectively. Psychrophilic, coliform and total plate count of the samples was determined as per the methods described by APHA (1984).

Sensory evaluation

The sensory evaluation of the product was carried for attributes, namely appearance and colour, flavour, juiciness, texture and the overall acceptability of fresh and stored samples by a panel of trained members composed of scientists and research scholars of the division based on a 8-point hedonic scale, wherein 8 denoted "extremely desirable" and 1 denoted "extremely undesirable" (Seman et al. 1987). The panels were trained for four basic tastes, i.e., recognition and threshold test and hedonic tests routinely performed in the division. Panelists were seated in a room free of noise and odours and suitably illuminated. Coded samples for sensory evaluation were prepared and served warm to panelists. Water was provided for oral rinsing between the samples.

Statistical analysis

The experiment was replicated six times and the values/data generated up to 7 days of storage were expressed as mean± SE. The statistical difference between the means was assessed by ANOVA-one way classification (Snedecor and Cochran 1980). A difference at $P<0.05$ was considered statistically significant.

Results and discussion

Physicochemical characters

The mean values of various parameters namely pH and proximate composition of aerobically packaged mutton *Harrisa* during storage at 4±1°C are presented in Table 1. The mean pH values of the mutton *Harrisa* observed on day 0 (6.06), day 4 (6.15) and day 7 (6.23) increased significantly ($P<0.05$) during refrigerated storage. This increase in product pH during storage might be due to accumulation of metabolites of bacterial action on meat and meat products and deamination of meat proteins (Bachhil 1982; Jay 1986). Similar increase in pH was also reported by Nag et al. (1998) in chicken nuggets, Kumar and Sharma (2004a, b) in chicken patties, Reddy et al. (2009) in pork sausages, Chidanandaiah et al. (2009) in buffalo meat patties, Sureshkumar et al. (2010) in buffalo meat sausages, Kumar and Tanwar (2010) in chicken nuggets and Bhat et al. (2010) in chevon *Harrisa*.

Table 1 Influence of refrigerated storage (4±1^{0}C) on physico-chemical properties of mutton *Harrisa*

Parameter	Storage days		
	0-day	4-day	7-day
pH	$6.1^{A}\pm0.01$	$6.2^{B}\pm0.01$	$6.2^{C}\pm0.01$
Moisture (%)	$74.7^{A}\pm0.15$	$73.7^{AB}\pm0.34$	$73.1^{B}\pm0.50$
Fat (%)	$10.5^{A}\pm0.35$	$11.4^{AB}\pm0.37$	$11.8^{B}\pm0.46$
Protein (%)	$12.1^{A}\pm0.37$	$12.5^{AB}\pm0.39$	$13.4^{B}\pm0.31$
Ash (%)	$2.1^{A}\pm0.18$	$2.5^{AB}\pm0.16$	$2.8^{B}\pm0.13$

Means with different superscripts in each row differ significantly ($P<0.05$), $n=6$ for all parameters.

The mean moisture percent values of the product decreased significantly ($P<0.05$) with storage period although, the moisture percent of the product on day 4 (73.71%) was comparable with moisture percent on the day 0 (74.73%) and day 7 (73.09%). Sharma and Rao (1996), Rao and Reddy (2000), Biswas et al. (2004), Ali and Rasool (2007), Chidanandaiah et al. (2009) and Bhat et al. (2010) have also reported a similar decrease in moisture content of the meat products with increasing storage period. This loss in moisture content of mutton *Harrisa* on refrigerated storage may be due to the surface loss of moisture by evaporation and due to the poor moisture barrier offered by the packaging material. The mean protein percentage values of mutton *Harrisa* on day 0, day 4 and day 7 are 12.10, 12.49 and 13.42 respectively. The mean protein percent values of the product showed a significantly ($P<0.05$) increasing trend throughout the period of storage. However, the mean protein percent of the product on day 4 was comparable with both day 7 and day 0. Similar trend was observed by Sharma and Rao (1996), Rao and Reddy (2000), Ali and Rasool (2007) and Bhat et al. (2010). The mean fat values of the product increased significantly ($P<0.05$) with storage period although, the fat percent of the product on day 4 (11.38%) was comparable with moisture percent on the day 0 (10.50%) and day 7 (11.78%). Similar observations were also reported by Sharma and Rao (1996), Rao and Reddy (2000) and Bhat et al. (2010). The mean ash percent values also showed a significantly ($P<0.05$) increasing trend with storage period although, the ash percent of the product on day 4 (2.52%) was comparable with ash percent on the day 0 (2.06%) and day 7 (2.84%). Similar increase in ash content was also observed by Sharma and Rao (1996), Rao and Reddy (2000), Ali and Rasool (2007) and Bhat et al. (2010). The loss of moisture

Table 2 Influence of refrigerated storage (4±1^{0}C) on microbiological and physicochemical characteristics of aerobically packaged mutton *Harrisa*

Quality attributes	Storage days		
	0	4	7
Total plate count (Log_{10} Cfu/g)	1.99±0.04^A	2.46±0.02^B	3.06±0.08^C
Psychrophillic count (Log_{10} Cfu/g)	Not detected	1.23±0.07^A	1.64±0.05^B
Coliform count (Log_{10} Cfu/g)	Not detected	Not detected	Not detected
FFA (% Oleic acid)	0.015±0.001^A	0.025±0.001^B	0.046 ±0.001^C
TBARS value (mg malonaldehyde per kg)	0.41±0.02^A	0.56±0.02^B	0.67±0.03^C

Means with different superscripts in a row differ significantly ($P<0.05$), $n=6$ for all parameters

in aerobically packaged mutton *Harrisa* during storage had reflected in significant ($P<0.05$) increase in mean protein, fat and ash percent values.

Microbiological and physicochemical characteristics

The mean values of various microbiological and physicochemical characteristics of aerobically packaged mutton *Harrisa* during storage at 4±1°C are presented in Table 2. Almost all the storage parameters showed a significant ($P<0.05$) increase with the storage period but the increment in all the parameters was within the limits of acceptability.

Microbiological characters

Microbiological studies indicated that the samples had significantly lower aerobic counts as cooking is reported to have pronounced effect in reducing bacterial load if done for longer times at higher temperature (Bryan et al. 1980).

Total plate count (Log_{10} Cfu/g)

The mean values of the total plate count increased significantly ($P<0.05$) throughout the storage period. Nag et al. (1998), Reddy and Rao (2000), Chidanandaiah et al. (2009), Kumar and Tanwar (2010) and Bhat et al. (2010) observed a similar increase in total plate count while studying different meat products stored at refrigeration temperature.

Psychrophilic count (Log_{10} Cfu/g)

The mean values of the psychrophilic count increased significantly ($P<0.05$) throughout the storage period which was in agreement with the findings of Rao and Reddy (2000), Chidanandaiah et al. (2009), Sudheer et al. (2010) and Bhat et al. (2010) who also observed a similar increase in psychrophilic count in various meat products during refrigerated storage.

Coliform count (Log_{10} Cfu/g)

The coliforms were not detected throughout the period of storage. It could be due to the destruction of these bacteria during cooking at high temperature, much above their death point of 57°C. Further, hygienic practices followed during the preparation and packaging of *Harrisa* could also be one of the reasons for the absence of coliforms. Similar results were reported by Dawson et al. (1975) in ground turkey patties,Kumar and Sharma (2004a, b) in pork patties, Kandeepan et al. (2010) in buffalo meat keema and Bhat et al. (2010) in chevon *Harrisa* who also reported zero count of coliform for the product heated to such a high temperature.

Free fatty acids (% Oleic acid)

The mean values of the free fatty acids (FFA) increased significantly ($P<0.05$) throughout the storage period and a similar trend was observed by Anand et al. (1991), Nayak and Tanwar (2004), Nagamallika et al. (2006), Modi et al. (2007), Modi et al. (2009) and Bhat et al. (2010) in different meat products during refrigerated storage.

Thiobarbituric acid reacting substances (mg malonaldehyde per kg)

Thiobarbituric acid reacting substances (TBARS) values of the mutton *Harrisa* also increased significantly ($P<0.05$) throughout the storage period. This increase in TBARS values with storage period might be due to the lipid

Table 3 Influence of refrigerated storage (4±1^{0}C) on sensory parameters of aerobically packaged mutton *Harrisa*

Parameters	Storage days		
	0-day	4-day	7-day
Appearance and colour	7.2^A±0.05	7.0^A±0.06	6.8^B±0.04
Flavour	7.2^A±0.05	7.1^A±0.05	6.9^B±0.04
Juiciness	7.3^A±0.06	7.2^A±0.05	7.1^B±0.05
Texture	7.4^A±0.04	7.1^B±0.05	6.8^C±0.04
Overall acceptability	7.2^A±0.05	7.1^A±0.05	6.8^B±0.06

Means with different superscripts in each row differ significantly ($P<0.05$), $n=21$ for each treatment

Hedonic scale 1–8 was used where 1=extremely poor, 8=extremely good

oxidation and the production of volatile metabolites in the presence of oxygen attributed to oxygen permeability of packaging material (Brewer et al. 1992). This was in agreement with the findings of Reddy and Rao (1997), Nag et al. (1998), Singh and Verma (2000), Chidanandaiah et al. (2009), Reddy et al. (2009), Modi et al. (2009), Kumar and Tanwar (2010), Sudheer et al. (2010) and Bhat et al. (2010) who also found a similar increase in TBARS values upon storage of different meat products.

Sensory parameters

Mean sensory scores of aerobically packaged mutton *Harrisa* during storage at 4±1°C are presented in Table 3. The mean scores of all the sensory parameters of mutton *Harrisa* decreased significantly ($P<0.05$) during refrigerated storage. However, the mean scores of all the sensory parameters except for texture on day 4 were comparable with both day 7 and day 0 scores. The decrease in appearance scores might be due to pigment and lipid oxidation. A decrease in appearance and colour scores of meat products with increase in storage period was also reported by Nag et al. (1998) in chicken nuggets, Kumar and Sharma (2004a, b) in chicken patties, Reddy et al. (2009) in pork sausages, Kilinc (2009) in anchovy patties and Bhat et al. (2010) in chevon *Harrisa.* Fat oxidation as indicated by increased TBARS values in aerobically stored *Harrisa* might be the reason for getting lower flavour and colour scores (Tarladgis et al. 1960). Also the material used for packing i.e. low density polyethylene which has poor moisture barrier would have added to the above said cause. Loss of moisture during storage caused the *Harrisa* to retain lesser juiciness and texture scores. Similar results were presented by Reddy and Rao (1997), Nag et al. (1998), Kilinc (2009), Reddy et al. (2009) and Bhat et al. (2010) in chicken patties, duck meat patties, anchovy patties and chevon *Harrisa* during refrigerated storage respectively. The scores for overall acceptability also decreased significantly ($P<0.05$) during storage. This decrease in overall acceptability scores during refrigerated storage might be reflective of the decline in scores of flavour, juiciness and texture attributes. The results of the study were in agreement with the findings of Awonrin (1993), Reddy and Rao (2000), Kilinc (2009), Reddy et al. (2009) and Bhat et al. (2010) who also reported a reduction in overall acceptability scores in chicken loaves, chicken sausage, anchovy patties and chevon *Harrisa* upon storage at refrigerated temperature. Furthermore, a gradual increase in FFA and TBA values explains the descending trend in the rating of sensory quality of the product during storage, and this has been reported by many researchers (Sen and Karim 2003; Andres et al. 2006; Modi et al. 2009).

Conclusions

Harrisa prepared from mutton was acceptable to the panelists at all periods of storage and had good physico-chemical properties with aerobic counts in acceptable range during 7 days of refrigerated storage at 4±1°C. Being a popular and spice rich meat based product of the state, it has a great market potential. It can be used for the utilization of spent/culled meat as well which promises to increase the profit margins of the meat industry. The product has a potential scope to be used as a meat spreader by improving its shelf life and as such there is ample scope regarding the shelf life of the product.

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