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Efficacy of Gooseberry, Tomato and Red Grapes Powder as Preservative in Restructured Chicken Block

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ABSTRACT

Use of natural preservatives to increase the shelf-life of meat products is promising because extracts or powders of many herbs, plants, vegetables and fruits have antioxidant and antimicrobial properties. Hence, the present study was planned to find out the effect of powders of red grapes, gooseberry and tomato on the quality and shelf life of restructured chicken block under refrigerated storage (7±1°C). Incorporation of powders at 1% level did not show any significantly effect on cooking yield (%) and proximate composition. A significantly (P<0.01) lower pH value was recorded for gooseberry powder added products. All the products added with fruit powders and BHT had significantly (P<0.01) lower thiobarbituric acid (TBA) values than control. Gooseberry added products were recorded to have significantly (P<0.01) lower TBA values on 14th, 17th and 20th day of storage. The free fatty acid (FFA) values were recorded to be significantly (P<0.01) lower in gooseberry added products compared to control products throughout the period of storage.

Keywords : *Gooseberry, Tomato, Red grapes, Natural preservative, Restructured chicken block, Refrigerated storage, Biochemical quality*

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INTRODUCTION

Poultry meat is relatively rich in polyunsaturated fatty acids (Bourre 2005) and lipid oxidation is one of the major problems in the development of new convenient meat products (Gray and Pearson 1987). The changes in the quality of meat products caused by lipid oxidation are manifested by adverse changes in colour, flavour, nutritive value and production of toxic compounds (Jensen *et al.* 1998). The most common strategies for preventing lipid oxidation are the use of antioxidants and restriction of access to oxygen (Tang *et al.* 2001). Grapes, gooseberry and tomato are rich source of polyphenolic compounds. The use of synthetic compounds with antioxidant properties like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) etc. are not encouraging in meat and allied industry due to their toxic potential and carcinogenic effect (Jayaprakasha *et al.* 2003). Hence, the present study was planned to find out the efficacy of powder of gooseberry, tomato and red grapes as functional preservatives especially as antioxidants on the quality and shelf life of the restructured chicken block.

MATERIALS AND METHODS

Chicken meat: Heavy weight broiler chickens were selectively procured from the market and slaughtered under hygienic condition in the semi-automatic poultry dressing unit in the Department of Livestock Products Technology (LPT), Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Puducherry. All the carcasses were deboned manually and cut into small chunks and stored in freezer (-18±1°C) till further use.

Preparation of restructured chicken block: Restructured chicken slices were prepared by using deboned broiler chicken meat and curing ingredients such as salt, sugar, sodium monobasic phosphate, nitrite and water following the procedure and recipe standardized in the Department of LPT, RIVER, Puducherry (Mandal *et al.* 2002). The standardized recipe for the product includes deboned meat (100%) with salt 2%, sugar 1%, phosphates 0.4%, nitrite 150 ppm and water 10% on meat weight basis. The frozen deboned meat was thawed by keeping the meat in the refrigerator (7±1°C) overnight. The thawed meat was minced by passing through 8 mm plate in a meat mincer (Mado Shop Mincer Junior, Germany). The minced meat was mixed manually with curing ingredients *viz.*, salt, sugar, phosphate, nitrite and water as per the recipe and then tumbled in home mixer grinder (Sumeet Machines Ltd, Mumbai). The tumbled mass was filled into clean stainless steel mould lined with food grade aluminium foil and covered with stainless steel lid and then kept overnight in refrigerator (7±1°C) for the curing reaction to take place. The moulds were cooked in water at 90°C for 45 minutes followed by cooling

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under tap water and chilling overnight in the refrigerator (7±1°C) for setting. Products were sliced to 3mm thickness using meat slicer (Sirmon SPA, Italy), packed in low density polyethylene bags in 200 g portions and stored under refrigeration (7±1°C). The samples were drawn on day 1, 6, 10, 14, 17 and 20 of storage to assess the efficacy.

Preparation and incorporation of powder of gooseberry, tomato and red grapes: Fresh tomatoes and red grapes were procured from local market at Puducherry. After washing and dicing, paste were prepared by grinding in home mixer grinder separately. Paste (1Kg) was later mixed with sunflower oil (30 ml) and drying was carried out at 50°C for 72 hours by using hot air oven. The dried paste were then pulverized using home mixer and sieved through a fine mesh. The resulting powder were then sealed in glass bottles and kept in freezer for further use. Fresh gooseberries were purchased from the local market at Puducherry. It was washed thoroughly under running tap water to remove extraneous matters. After slicing, it was dried under the shade for 8 hours followed by final drying carried out at 50°C for 2 hours in hot air oven. The dried gooseberries were ground mechanically using home mixer grinder and sieved through a fine mesh. Later it was stored in a bottle and kept in freezer for further use.

Powder of all the three at 1.0 % level were incorporated in the standard recipe of the restructured chicken block separately. Similar to experimental products, a reference product with BHT and a control product (without any fruit powder or BHT) were prepared. After preparation of the test products and control, they were sliced to 3mm thickness and packed in low density polyethylene (LDPE) bags (200 gauge) and stored under refrigeration (7±1°C). The samples were drawn on 1, 6, 10, 14, 17 and 20th day to assess physicochemical qualities.

Cooking yield: The cooking yield of the product was determined in accordance with the standard procedure carried out by Murphy *et al.* (1975). The weight of restructured meat blocks were recorded before and after cooking. The cooking yield was calculated and expressed in percentage.

Physico-chemical Analysis

Proximate composition: The moisture, protein, fat and total ash contents of restructured chicken block were determined by standard methods of analysis in accordance with AOAC (1995).

pH: The pH of chicken meat was determined by adopting the procedure laid down by AOAC (1995) using combined glass electrode of the pH meter (ELICO Model LI-120).

Thiobarbituric acid (TBA) value: The distillation method described by Tarladgis *et al.* (1960) was followed for the determination of TBA value. The TBA value was calculated and expressed as mg of malonaldehyde per kg of sample.

Tyrosine value: Tyrosine value of restructured chicken slice was estimated adopting the procedure of Strange *et al.* (1977). Tyrosine value was calculated and expressed as mg of tyrosine per 100g of meat.

Free fatty acids (FFA) value:Free fatty acids were estimated based on the modified AOAS method (1970). The FFA was calculated and expressed as percent oleic acid.

Statistical analysis:Each experiment was replicated thrice and each parameter was analyzed in duplicate. The data recorded were analyzed using SPSS version 17.0 (SPSS, Chicago, U.S.A). One way analysis of variance (ANOVA) was used for cooking yield and for all the other parameters, two way analysis of variance was applied and the data were tabulated. The level of significant effects were tested by comparing mean values using the least significant difference (LSD) test at 1 and 5% level (Snedecor and Cochran 1967).

RESULT AND DISCUSSION

Cooking yield: No significant differences were observed on the cooking yield (%) of restructured chicken slices incorporated with natural and synthetic antioxidants. The cooking yield (%) variedfrom 99.15±0.56 to 99.82±0.07. Similarly, Brannan (2008) reported that chicken patties formulated with grapes seed extract (0.1%) did not show any significant differences in the cooking yield when compared to control products.

Proximate composition: No significant differences were noticed for moisture (72.13-72.33%), protein (19.11 – 19.47%), fat (4.21 – 4.29%) and ash (2.30 – 2.38%) content among the treatments and control products (Table 1). These values are in close agreement with the observations reported by Mandal *et al.* (2002), Sudheer *et al.* (2011a). No significant effect on the moisture, protein and ash contents in meat products due to incorporation of tomato paste (Candogan 2002) and tomato powder (Kim *et al.* 2010) were already reported.

Table 1: Effect of gooseberry, tomato and red grapes powders and BHT on the proximate composition of restructured chicken block during refrigerated storage (7±1^{0}C) (Mean±SD)

		Treatments			
Parameters		**T1**	**T2**	**T3**	**T4**
Moisture (%)					
	1 Day	72.33±0.12	72.25±0.09	72.13±0.07	72.29±0.11
	20 Day	72.25±0.04	72.16±0.11	72.09±0.02	72.21±0.10
Protein (%)					
	1 Day	19.11±0.16	19.28±0.09	19.32±0.03	19.24±0.09
	20 Day	19.30±0.11	19.40±0.11	19.47±0.06	19.36±0.07
Crude Fat (%)					
	1 Day	4.21±0.03	4.25±0.02	4.26±0.04	4.23±0.02
	20 Day	4.24±0.04	4.28±0.02	4.29±0.05	4.27±0.02
Total Ash (%)					
	1Day	2.30±0.02	2.34±0.04	2.36±0.02	2.33±0.03
	20 Day	2.33±0.04	2.37±0.02	2.38±0.02	2.35±0.03

n=6; C= Control without preservative, T1= 200ppm BHT, T2 = 1% red grapes powder, T3= 1% gooseberry powder, T4= 1% tomato powder

The pH values: The pH values of the restructured chicken slices varied significantly (P<0.01) among the test products with the lowest values recorded in gooseberry powder added products (6.06- 6.12) throughout the storage period (Table 2). The lower pH values in the gooseberry powder added products might be because of the presence of chemicals like gallic acid, elagic acid, phyllemblic acid and indol acetic acid. Control products showed comparatively higher pH values throughout the storage period and on 20th day of storage the difference became significant (P<0.01). Similar to our observations, Brannan (2008) reported that addition of grape seed extract even at 0.1% in chicken patties had lowered its pH compared to control. Kim *et al*. (2010) and Candogan (2002) also observed that the incorporation of tomato powder/paste significantly (P<0.05) reduced the pH values of pork sausage and beef patties, respectively.

The TBA values: All the products added with natural antioxidants and BHT had significantly (P<0.01) lower TBA values. In all the products, TBA values increased gradually and significantly (P<0.01) over the period of storage but rate of increase was lowest in the products added with gooseberry powder followed by red grapes powder, BHT, tomato powder and control products. No significant differences were observed on the TBA values of both tomato powder and BHT added products on 20th day of storage. Similarly, Banon *et al.* (2007), Lau and King (2003) and Carpenter *et al.* (2007) reported that grape seed extract significantly (P<0.05) reduced TBARS values of beef, chicken and pork, respectively. Inhibition of the formation of lipid hydroperoxides and thiobarbituric acid reactive substances by the addition of grape seed extract and tomato powder in various meat products has been reported by Brannan and Mah (2007) and Eyilet and Oztan (2010) during refrigerated storage.

Tyrosine values: A slow but gradual significant (P<0.01) increase in tyrosine values of all the treated and control samples were noticed during storage (Table 2). Similar trends of increase in the tyrosine value with the advancement of storage days were reported by Mandal *et al.* (2002), Sudheer *et al.* (2011a) in various meat products. Gooseberry powder treated product had significantly (P<0.01) higher tyrosine value than all other treated and control samples. Significantly (P<0.01) higher tyrosine values of gooseberry powder added products might be attributed to the extremely high polyphenolic contents of gooseberry (24.5 ± 1.11g GAE/100g) as reported by Mishra *et al.* (2009).

Free fatty acid values: Significantly (P<0.01) lower FFA values were recorded in gooseberry added products compared to control products throughout the period of storage (Table 2). FFA values of product added with red grapes and tomato powder did not vary significantly throughout the storage period but these values were significantly (P<0.01) lower compared to control product throughout the period of storage.

Table 2: Effect of gooseberry, tomato and red grapes powders on physico-chemical quality of restructured chicken block during refrigerated storage (7±1^{0}C) (Mean±SD)

Treatments	Storage period (days)					
	1	6	10	14	17	20
			pH			
Control	6.39±0.005^{dB}	6.38±0.01^{dA}	6.38±0.008^{dA}	6.41±0.005^{dC}	6.41±0.009^{eC}	6.43±0.007^{eD}
T1	6.38±0.008^{dBC}	6.36±0.005^{dA}	6.37±0.02^{dAB}	6.36±0.009^{cA}	6.38±0.005^{dBC}	6.40±0.006^{dC}
T2	6.28±0.004^{bB}	6.26±0.01^{bAB}	6.26±0.008^{bAB}	6.24±0.02^{bA}	6.25±0.01^{bA}	6.27±0.006^{bAB}
T3	6.12±0.01^{aB}	6.09±0.02^{aAB}	6.08±0.02^{aAB}	6.06±0.04^{aA}	6.07±0.02^{aAB}	6.09±0.008^{aAB}
T4	6.31±0.005^{cB}	6.29±0.01^{cA}	6.30±0.004^{cAB}	6.28±0.02^{bA}	6.29±0.007^{cA}	6.30±0.007^{cAB}
			TBA values (mg of malonaldehyde per kg of sample)			
Control	0.31±0.05^{bA}	0.60±0.02^{dB}	1.04±0.15^{cC}	1.68±0.05^{cD}	2.12±0.11^{cE}	2.48±0.14^{cF}
T1	0.24±0.01^{aA}	0.37±0.01^{bcB}	0.59±0.11^{abC}	0.74±0.03^{bD}	1.09±0.12^{bE}	1.28±0.08^{bF}
T2	0.23±0.04aA	0.35±0.03^{abA}	0.55±0.09^{abB}	0.71±0.03^{bC}	1.06±0.12^{bD}	1.24±0.14^{bE}
T3	0.21±0.03^{aA}	0.32±0.01^{aA}	0.46±0.06^{aB}	0.56±0.10^{aB}	0.88±07^{aC}	1.01±0.11^{aD}
	0.27±0.05^{abA}	0.40±0.03^{cB}	0.64±0.06^{bC}	0.81±0.07^{bD}	1.17±0.10^{bE}	1.40±.07^{bF}
			Tyrosine values (mg/100 g)			
Control	3.11±0.09^{aA}	3.33±0.09^{aA}	3.98±0.08^{aB}	4.40±0.01^{aC}	4.77±0.09^{aD}	5.35±0.20^{aE}
	3.06±0.03^{aA}	3.31±0.03^{aA}	3.95±0.07^{aB}	4.32±0.12^{aBC}	4.68±0.17^{aC}	5.20±0.22^{aD}
	3.95±0.02^{aA}	4.02±0.01^{aA}	4.11±0.01^{aAB}	4.23±0.03^{aAB}	4.40±0.05^{aB}	4.84±0.39^{aC}
	26.42±0.47^{bA}	26.88±0.41^{bAB}	27.16±0.52^{bAB}	27.38±0.74^{bAB}	27.93±0.14^{bAB}	28.69±0.19^{bB}
	3.21±0.08^{aA}	3.46±0.02^{aAB}	3.77±0.07^{aBC}	4.05±0.10^{aCD}	4.35±0.14^{aDE}	4.76±0.46^{aE}
			FFA values (% oleic acid)			
Control	0.31±0.009^{bA}	0.36±0.01^{cB}	0.47±0.03^{cC}	0.54±0.01^{cD}	0.63±0.03^{cE}	0.73±0.02^{cF}
T1	0.30±0.01^{abA}	0.35±0.02^{cA}	0.44±0.01^{bcB}	0.50±0.04^{bcC}	0.58±0.02^{bD}	0.69±0.05^{cE}
T2	0.29±0.009^{abA}	0.32±0.01^{abA}	0.40±0.03^{bB}	0.45±0.03^{abC}	0.53±0.03^{abD}	0.62±0.05^{bE}
T3	0.28±0.006^{aA}	0.30±0.009^{aA}	0.35±0.01^{aB}	0.41±0.02^{aC}	0.48±0.02^{aD}	0.55±0.02^{aE}
T4	0.30±0.003^{abA}	0.34±0.007^{bcB}	0.41±0.01^{bC}	0.47±0.03^{bD}	0.56±0.03^{bE}	0.65±0.01^{bcF}

n=6; C= Control without preservative, T1= 200ppm BHT, T2 = 1% red grapes powder, T3= 1% gooseberry powder, T4= 1% tomato powder
Means with different superscripts (capital letters in the same row and small letters in the same column) differ significantly ($P<0.01$)

Similar to our observations, Reddy *et al.* (2004) reported that biscuit formulated with gooseberry extract showed a lower FFA value compared to control samples.

CONCLUSION

Based on the results of this study, it may be concluded that antioxidant properties of red grapes, tomato and gooseberry powders are very well comparable to that of BHT and they can be used as functional preservatives by substituting the chemical antioxidant in the formulation of restructured meat products.

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