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Research Paper

Shelf Life of Enrobed Chicken Bites Treated with Guava Extract

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ABSTRACT

The present study was conducted to evaluate the shelf life of enrobed chicken bites (ECB) with guava fruit extract at refrigerated storage (4±1^{0}C). White Guava Extract (WGE-1%), Red Guava Extract (RGE- 1%) and BHA (100 mg/kg) were incorporated in batter mix used for enrobing chicken bites. The products were aerobically packaged in low density polyethylene (LDPE) pouches and analyzed at an interval of 5 days during refrigerated storage (4±1^{0}C). The storage period brought about significant changes in pH, TBA values, psychrophilic count (PC) and total plate count (TPC) which showed linear increasing trend from 0 to 15th day of refrigerated storage in treated as well as controlproducts. TPC and PCwere in acceptable limits for control, BHA, RGE and WGE treated products, respectively.The sensory scores of treated and control samples for appearance, flavour, texture, juiciness and overall acceptability showed a progressive decline with increase in storage period but the scores were rated above good.

Keywords : *Enrobing, Chicken bites, Guava extract, Shelf life*

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INTRODUCTION

India has produced 2.2 million tones of poultry meat which is 2.44% of the total poultry meat produced around the world. The market of processed meat is just 4-5% of the total chicken consumption in India. So, processing of chicken is essential to exploit its undermined potential and can provide tasty, convenience and designer products to non vegetarians.

Enrobing is a process wherein foods are traditionally coated with edible materials in the form of batter to provide the processors an opportunity to prepare value added products at a low cost. It improves their cooking yield, enhances sensory qualities and provides better protection against oxidative and microbiological deterioration. Further, enrobing of meat products provides advantages such as preserving the nutritive value, preventing moisture and weight loss, improving juiciness and tenderness (Biswas *et al*. 2004). These improvements are brought about by the coating ingredients which act as sealants and also prevent high oil uptake during frying of the product (Cunningham 1983). Breading on the fried meat enhances texture, flavour and appearance of the product. Therefore, attempts have been made in the past to enrobe the meat products by using coating materials such as bengal gram, alginate, egg, bread crumps, etc. (Biswas *et al.* 2003; Chidanandaiah *et al.* 2006; Manjhi 2013).

However, processed poultry meat products are very susceptible to oxidative deterioration because they contain a high proportion of polyunsaturated fatty acids (PUFA) (Higgins *et al*. 1998). Besides phospholipids, ferrous iron released from porphyrin ring of myoglobin, act as a catalyst in oxidation of phospholipids, causing warmed-over flavour in cooked meat products. Moreover brown colouration caused by the metmyoglobin formation, is a consequence of lipid peroxidation.

Antioxidants are first line of defence against free radical damage and critical for maintaining optimum health and wellbeing. For last few decades, synthetic antioxidants such as butylatedhydroxyanisole (BHA), butylatedhydroxytoluene (BHT), tert-butylhydroquinone (TBHQ) have been used in meat products. But, these additives have some potential toxicological effects (Jayathilakan *et al.* 2007; Naveena *et al.*2008). Epidemiological studies have revealed that frequent consumption of natural antioxidants is associated with a lower risk of cardiovascular disease and cancer (Renaud *et al.* 1998). The defensive effects of natural antioxidants in fruits and vegetables are related to three major groups: vitamins, phenolics, and carotenoids. The antioxidant and antimicrobial potential of pomegranate peel and seed extract in chicken products was investigated by Kanatt *et al.* (2010). The efficacy of pomegranate juice, pomegranate rind powder extract and butylated hydroxyl toluene as antioxidants in cooked chicken patties during refrigerated storage was observed by Naveena *et al.* (2008). Tea catechins were found to be more efficient than α-tocopherol in inhibiting minced muscle lipid oxidation in fresh meats, poultry and fish (Tang *et al.*2001).

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However, the literature on the use of Guava (*Psidium guajava* L.), as an antioxidant, is limited. Verma *et al*.(2013) employed guava powder (0.5 %, 1 %) as a source of antioxidant dietary fibre in sheep meat nuggets. Guava powder is rich in dietary fibre (43.21%), phenolics (44.04 mg GAE/g) and possesses good radical scavenging activity as well as reducing power. Guava powder was found to retard lipid peroxidation of cooked sheep meat nuggets as measured by TBARS number during refrigerated storage. Guava now being recognized as "*super food*" is inviting much attention in the agro-food business because of possession of certain health promoting bioactive components. It contains ascorbic acid (50–300 mg/100 g fresh weight) which is three to six times higher than oranges (Mercadante *et al.* 1999). Phenolic compounds such as myricetin and apigenin (Miean and Mohamed 2001), ellagic acid, and anthocyanins have been reported at high levels in guava fruits which are contributing for antioxidant and antimicrobial activities. Therefore, the present study was designed to assess the shelf life of enrobed chicken bites with pre-standardized levels of white and red guava fruit extract and was compared with BHA and control products under refrigerated storage (4 ± 1^0C).

MATERIALS AND METHODS

Source of materials: Chicken meat was procured from the retail shop in Nagpur and the fat, tendons and connective tissue were separated from the deboned meat, packaged in LDPE pouches and kept at refrigeration temperature (4±1°C) overnight until its use in product making.Different spice ingredients were dried in hot air oven at 50±1°C for 2 h and were ground in a grinder using suitable blade. All the ground spices were sieved through a fine mesh. Spice mix was prepared by admixing each ingredient and subsequently used in the formulation of chicken bites. Fine condiment paste was made by blending onion, ginger and garlic in a ratio of 3:1:1 in a grinder with a suitable blade.

Preparation of guava extract: The Red Guava Fruit (RGF) powder was prepared by washing the Red Guava fruits with distilled water, cut into pieces, dried in a hot air oven at 50°C for 48 h, then ground to a fine powder and passed through a 24-mesh sieve.Similar protocol was followed for the preparation of White Guava Fruit (WGF) powder. For preparation of 1% , 2% and 3% extract, both powders were added separately in the concentration of 1000 mg/kg, 2000 mg/kg and 3000 mg/kg of emulsion respectively in 100 ml boiled distilled water. After 1 h, the extract was obtained by filtering through Whatman filter paper no. 1 and respective extracts were added in the batter mix.

Preparation of enrobed chicken bites: Meat was minced in mincer (Stadler Corporation, Mumbai), salt, nitrite and sodium tripolyphosphate were added and the mixture was chopped in bowl chopper (Stadler Corporation, Mumbai) for 2 min. Ice flakes, whole egg liquid, vegetable oil, spice mix, condiments, extenders (soy flour) were added and chopped for few min. The emulsion was then moulded in stainless steel tiffin boxes and steam cooked for 20 min. The cooked meat blockwas cut into 1cm cubes, enrobed in batter mix with or without selected levels of either natural or synthetic antioxidants, breaded with bread crumbs and fried for 2-3 min. The batter mix was formulated as per Biswas *et al.* (2003) with certain modifications based on sensory evaluation.

Shelf life assessment: Enrobed chicken bites incorporated with 1% of red and white guava extract were packaged aerobically and stored in low density polyethylene pouches (200 gauge) at refrigerated temperature (4 ± 1^0C). The products were analyzed for pH, TBA value, peroxide value, microbiological quality (total plate count, psychrophilic count, coliform count) and sensory attributes (general appearance, flavor, texture, juiciness and overall palatability) at an interval of 5 days until visible slime was detected.

Physico-chemical parameters: The pH was measured by using a combined glass electrodewith a digital pH meter. Thiobarbituric acid value of samples during storage was determined by using the method described by Witte *et al*. (1970). Peroxide value of the product during storage study was determined by using standard procedure of AOAC (1995).

Microbiological parameters: Total plate count (TPC), psychrophilic count (PC) and coliform counts in the samples during storage period were determined as per the method described by APHA (1984). Readymade media from Hi-media Laboratories Pvt. Ltd., Mumbai were used for the enumeration of microbes.

Sensory parameters: Sensory evaluation was conducted using an eight point descriptive scale (Keeton 1983). Panel consisting of academic staff members and postgraduate students of Department of Livestock Products Technology have evaluated the samples for sensory attributes.

Statistical Analysis: The data obtained during the experiment were analyzed by Analysis of Variance following the procedure described by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Physico-chemical parameters: The *pH* observations pertaining to pH, TBA value and peroxide value of control as well as treated products have been presented in Table 1.There was significant ($p<0.05$) increase in pH values of control as well as treated enrobed chicken bites with progressive storage period. This increase in pH could be as a result of protein breakdown and liberation of protein metabolites, mainly amines due to bacterial activity during storage (Jay 1996). Yadav and Sharma (2008) also found significant ($p<0.05$) increase in pH of control as well as enrobed patties during 28 days of storage. Manjhi (2013) also documented similar observations in enrobed chevon balls treated with grape seed extract and tea polyphenols.

Thiobarbituric acid (TBA) values: The TBA values of enrobed chicken bites increased significantly ($p<0.05$) throughout the storage period. Among the treated products, TBA values were lower in white guava extract (WGE) treated enrobed chicken bites followed by red guava extract (RGE) and BHA. The TBA value was significantly ($p<0.05$) higher in control as compared to other treatments. This increase in TBA values with storage period might be due to lipid oxidation and production of volatile metabolites attributed to oxygen permeability of packaging material. Present findings were in agreement with the finding of Garg and Mendiratta (2006), Yadav and Sharma (2008), Bhat *et al.* (2011), Sudheer *et al.* (2011), Verma *et al*. (2013) and Reddy *et al.* (2013) in different products. However, the TBA values during the storage period were below the minimum threshold value i.e. 1-2 mg malonaldehyde/kg meat.

Peroxide value (PV): The PV mostly serves as an indicator of the extent of oxidation of lipids, fats and oils. PV measures the lipid peroxides, which are primary products of lipid oxidation. The results indicated significant ($p<0.05$) rise in PV of chicken bites during refrigerated storage which could be the result of catalysis of intracellular compounds due to the obliteration of the cell structure by NaCl and processing (Juntachote *et al*. 2006). Significant ($p<0.05$) decrease in PVs were observed in the treated products in comparison to control. It was also evident that the products with natural antioxidants revealed significantly ($p<0.05$) low PV as compared to synthetic antioxidant (BHA). This might be due to high phenolics present in guava fruit extract than the

Table1: Effect of natural antioxidants on physico-chemical parameters of enrobed chicken bites during refrigeration storage (4±1^{0}C)

Type of Product	Storage period (Days)					Treatment (Mean±S.E.)
	0	5	10	15	20	
			pH			
Control	6.07±0.026	6.24±0.021	6.31±0.016	6.42±0.009	6.46±0.020	6.30^B±0.03
BHA	6.14±0.010	6.26±0.014	6.28±0.016	6.36±0.008	6.44±0.018	6.29^B±0.025
RGE	6.12±0.013	6.27±0.035	6.31±0.008	6.35±0.015	6.42±0.035	6.29^B±0.025
WGE	6.15±0.020	6.21±0.006	6.24±0.035	6.30±0.046	6.37±0.024	6.25^A±0.019
Storage Period (Mean±S.E.)	6.12^a±0.012	6.24^b±0.008	6.29^c±0.010	6.36^d±0.013	6.42^e±0.014	
			TBA (mg malanoaldehyde/kg)			
Control	0.270±0.017	0.309±0.026	0.407±0.001	0.505±0.002	0.619±0.029	0.422^D±0.031
BHA	0.253±0.014	0.283±0.002	0.353±0.013	0.424±0.020	0.518±0.036	0.366^C±0.023
RGE	0.239±0.001	0.272±0.017	0.325±0.031	0.386±0.031	0.454±0.026	0.335^B±0.014
WGE	0.235±0.002	0.261±0.008	0.304±0.018	0.376±0.020	0.423±0.024	0.320^A±0.017
Storage Period (Mean±S.E.)	0.249^a±0.004	0.281^b±0.005	0.347^c±0.011	0.423^d±0.015	0.503^e±0.022	
			Peroxide value (meq/kg fat)			
Control	0.783±0.001	1.445±0.015	2.319±0.018	2.780±0.042	3.467±0.058	2.159^D±0.232
BHA	0.714±0.001	1.231±0.005	1.92±0.006	2.463±0.034	2.847±0.024	1.836^C±0.190
RGE	0.566±0.002	0.943±0.006	1.333±0.008	1.850±0.014	2.285±0.047	1.396^B±0.150
WGE	0.548±0.029	0.919±0.025	1.308±0.018	1.815±0.005	2.189±0.014	1.356^A±0.144
Storage Period (Mean±S.E.)	0.653^a±0.029	1.135^b±0.065	1.721^c±0.127	2.227^d±0.124	2.697^e±0.154	

Mean ± SE with different superscripts in a row differ significantly ($p<0.05$).

synthetic one (BHA). Moreover, the lowest PV was recorded for chicken bites added with WGE.

Microbiological parameters: The microbiological quality (in terms of total plate count, psychrophilic count and coliform count) for the aerobically packaged control as well as treatment products as detected on 0, 5, 10, 15 and 20th day of refrigerated storage (4 ± 1^0C) were presented in Table 2.

Total plate count: The mean values of the total plate count (TPC) for control as well as treatment products increased significantly ($p<0.05$) upon its assessment at regular interval. Chidanandaiah *et al.* (2009), Bhat *et al.* (2011) and Kumar and Tanwar (2011) observed a similar increase in TPC while studying different meat products stored at refrigerated temperature. However, the TPC even after 20 days of storage, were well below the permissible limit i.e. $\log_{10}7$ cfu/g for cooked meat products (Jay 1996). The TPC in treated products incorporated with WGE and RGE during storage were significantly lower ($p<0.05$) than control. However, TPC in product with WGE were significantly lower ($p<0.05$) than other treatment products on 15 and 20th day of storage. The lower TPC in treatment products could be attributed to the antimicrobial properties of guava extracts in enrobed chicken

Psychrophilic count: The psychrophilic counts (PC) were not observed in control as well as treated products upto 5th day of storage. Thereafter, psychrophilic count increased significantly ($p<0.05$) throughout the study. These findings were in agreement with Chidanandaiah *et al.* (2009), Sudheer *et al.* (2011) and Bhat *et al.* (2011), who observed similar increase in psychrophilic count in various meat products during refrigerated storage. In present study, PC always remained below the threshold value for cooked meat products i.e. $\log_{10}4$ cfu/g (Jay 1996). The PC in treatment products incorporated with WGE and RGE on 15th and 20th day of storage were significantly lower ($p<0.05$) than control which could be due to the antimicrobial properties of guava extract in enrobed chicken bites.

Coliform count: *Salmonella* and *E. coli* were not detected in the enrobed chicken bites either with or without antioxidants even at the end of storage study. Similar observations were also recorded by Bhat *et al*. (2011). These bacteria are indicator of fecal contamination. Absence of these microorganisms indicated no contamination during post processing handling of enrobed chicken bites.

Sensory parameters: It was evident from Table 3, the appearance of the enrobed chicken bites was significantly ($p<0.05$) higher in product treated with natural antioxidants. This might be due to the fact that natural antioxidants present in guava improved the color stability of meat products during storage. The appearance of the products was found to vary in the order of WGE>RGE>BHA>Control. It was also observed that the appearance of the products decreased significantly ($p<0.05$) and gradually during 20 days of refrigerated storage. It was deduced that the decrease in appearance scores during refrigerated storage period might be mostly due to non-enzymatic browning of product as the sequel of pigment and

Table 2: Effect of natural antioxidants on microbiological quality of enrobed chicken bites during refrigeration storage

Type of Product	Storage period (Days) 0	5	10	15	20	Treatment (Mean±S.E.)
			Total plate count ($\log_{10}$cfu/g)			
Control	1.23±0.031	2.08±0.017	2.84±0.018	3.19±0.011	3.65±0.077	$2.60^D\pm0.208$
BHA	1.17±0.017	1.91±0.029	2.75±0.041	3.06±0.014	3.56±0.063	$2.49^C\pm0.207$
RGE	1.05±0.052	1.92±0.008	2.41±0.030	2.97±0.020	3.52±0.081	$2.37^B\pm0.208$
WGE	0.92±0.027	1.82±0.027	2.39±0.011	2.89±0.031	3.37±0.055	2.28A±0.207
Storage Period (Mean±S.E.)	$1.09^a\pm0.038$	$1.93^b\pm0.029$	$2.59^c\pm0.062$	$3.03^d\pm0.034$	$3.52^e\pm0.043$	
			Psychrophilic count ($\log_{10}$cfu/g)			
Control	ND	N D	0.18±0.029	0.62±0.06	1.45±0.054	$0.75^D\pm0.132$
BHA	N D	N D	0.16±0.029	0.49±0.011	1.06±0.059	$0.57^C\pm0.092$
RGE	N D	N D	0.17±0.024	0.42±0.086	0.99±0.029	$0.53^B\pm0.086$
WGE	N D	N D	0.15±0.035	0.38±0.017	0.91±0.033	$0.48^A\pm0.080$
Storage Period (Mean±S.E.)	N D	N D	$0.16^a\pm0.045$	$0.47^b\pm0.021$	$1.10^c\pm0.064$	

ND – Not detected; Mean ± SE with different superscripts in a row differ significantly ($p<0.05$).

lipid oxidation (Suradkar 2008). It was recorded that the flavour and the juiciness of the products containing antioxidants were significantly ($p<0.05$) higher as compared to the control. The flavour and juiciness were significantly ($p<0.05$) higher in WGE treated enrobed chicken bites throughout the storage period. These findings might be reasoned to the presence of phenolic compounds and carotenoids in WGE (Vrinda and Uma Devi 2001; Jayaprakasha *et al*. 2001and Shi *et al*. 2003).

It was observed that texture score of all samples decreased significantly ($p<0.05$) throughout storage period. The WGE treated enrobed chicken bites were superior in texture than other products. However, decreased texture scores at the end of storage might be due to release of moisture (Wu *et al*. 2000) and changes in the properties of the proteins and fat during storage. The results evidenced significant reduction ($p<0.05$) in overall palatability of the treated as well as control products throughout storage period. WGE treated product gained highest overall palatability during the refrigeration storage period. These findings were in corroboration with the results of Biswas *et al*. (2003) who observed higher scores for all the sensory attributes of enrobed pork patties containing antioxidant than control during the entire storage period.

Table 3: Effect of natural antioxidants on sensory parameters of enrobed chicken bites during refrigeration storage

Type of Product	Storage period (Days)					Treatment (Mean±S.E.)
	0	5	10	15	20	
			Appearance			
Control	6.33	6.1	6.06	5.69	5.56	$5.95^{A}\pm0.085$
BHA	6.54	6.39	6.18	6.11	5.98	$6.28^{B}\pm0.071$
RGE	6.86	6.46	6.38	6.21	6.12	$6.41^{B}\pm0.085$
WGE	7.15	6.99	6.75	6.6	6.41	$6.89^{C}\pm0.067$
Storage Period (Mean±S.E.)	$6.72^{c}\pm0.113$	$6.48^{b}\pm0.119$	$6.34^{ab}\pm0.081$	$6.19^{a}\pm0.148$	$6.11^{a}\pm0.121$	
			Flavour			
Control	6.33	5.91	6.02	5.69	5.39	$5.87^{A}\pm0.102$
BHA	6.29	6.06	6.15	5.72	6.08	$6.06^{A}\pm0.080$
RGE	6.76	6.19	6.42	6.18	6.08	$6.32^{B}\pm0.079$
WGE	7.42	7.12	7.03	6.92	6.80	$7.08^{C}\pm0.083$
Storage Period (Mean±S.E.)	$6.70^{c}\pm0.053$	$6.32^{ab}\pm0.066$	$6.38^{b}\pm0.058$	$6.17^{ab}\pm0.054$	$6.07^{a}\pm0.030$	
			Juiciness			
Control	6.27	5.71	5.86	5.58	5.16	$5.72^{A}\pm0.103$
BHA	6.47	5.69	6.00	5.92	5.66	$5.95^{AB}\pm0.106$
RGE	6.92	6.14	6.06	6.09	6.00	$6.24^{B}\pm0.124$
WGE	7.14	6.6	6.86	6.96	6.75	$6.86^{C}\pm0.135$
Storage Period (Mean±S.E.)	$6.71^{b}\pm0.141$	$6.03^{a}\pm0.096$	$6.20^{a}\pm0.086$	$6.02^{a}\pm0.092$	$6.01^{a}\pm0.083$	
			Texture			
Control	6.35	6.01	5.81	5.54	5.46	$5.83^{A}\pm0.110$
BHA	6.41	5.97	6.06	5.79	5.68	$5.98^{AB}\pm0.097$
RGE	6.43	6.45	5.99	6.16	5.84	$6.17^{B}\pm0.089$
WGE	7.11	6.87	6.73	6.83	6.40	$6.95^{C}\pm0.121$
Storage Period (Mean±S.E.)	$6.57^{b}\pm0.101$	$6.32^{ab}\pm0.053$	$6.15^{a}\pm0.125$	$6.06^{a}\pm0.020$	$6.02^{a}\pm0.098$	
			Overall palatability			
Control	6.24	5.99	5.79	5.61	5.57	$5.84^{A}\pm0.098$
BHA	6.30	6.21	6.27	5.94	5.83	$6.14^{B}\pm0.078$
RGE	6.60	6.27	6.27	6.28	6.25	$6.36^{B}\pm0.061$
WGE	7.52	7.23	7.02	6.89	6.76	$7.18^{C}\pm0.091$
Storage Period (Mean±S.E.)	$6.66^{b}\pm0.162$	$6.42^{ab}\pm0.106$	$6.33^{a}\pm0.093$	$6.22^{a}\pm0.102$	$6.23^{a}\pm0.088$	

Mean ±SE with different superscripts in a row differ significantly ($p<0.05$).
Mean values are scores on 8 point descriptive hedonic scale where 1= extremely poor and 8= extremely desirable

CONCLUSION

From the present study, it is concluded that aerobically packaged enrobed chicken bites incorporated with either 1% WGE or RGE were acceptable for 20 days of refrigerated storage (4 ± 1^0 C) without any adverse effect on physico-chemical, microbiological and sensory qualities. WGE and RGE can be effectively selected by the meat processing industry in near future over synthetic antioxidants (BHA).

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