International Journal of Meat Science

ISSN 2071-7113

science alert

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International Journal of Meat Science 2 (2): 27-33, 2012
ISSN 2071-7113 / DOI: 10.3923/ijmeat.2012.27.33

Garcinia cambogia Fruit Extract Enhances the Shelf Life of Pork Fry in Room Temperature

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ABSTRACT

Natural preservation of meat and meat products is one of the important areas of meat science research. It was observed that the traditional pork curry (with addition of *Garcinia cambogia* fruit extract) of Coorg district, Karnataka, India had a longer shelf-life and higher acceptability. Hence, a study was conducted to assess the bio-preservative effect of the aqueous extract of *G. cambogia* fruit (Kachampuli in Coorgi). The pork cubes of 1 cm^3 were marinated with salt (1.75%) and dry spice mixture (2%), shallow fried in low flame for 45 min in sunflower oil (10%) along with the green curry stuff. The aqueous extract of *G. cambogia* fruit was added at levels of 1 and 2%. The treated products along with a control were stored at room temperature analyzed for physico-chemical, microbiological and sensory quality. The results indicated that the pH of the pork fry was significantly ($p<0.05$) lower in the treatment 1 and 2 (5.32 and 5.1) compared to the control (5.84). The Thiobarbituric acid reacting substances (TBARS) and tyrosine values of the pork fry with 1% extract (1.65 mg malonaldehyde kg^{-1} and 5.57 mg kg^{-1}) were also significantly ($p<0.05$) lower than that of the control (1.94 mg malonaldehyde kg^{-1} and 6.73 mg kg^{-1}). The standard plate count remained within safe limits up to 6th day of storage in case of the treatments (3.84 log colony forming units $gram^{-1}$) whereas, the control samples with SPC of 4.92 log CFU g^{-1} deteriorated after 48 h of preparation. The flavor, texture, juiciness and overall acceptability were better for both the treated pork fry throughout the study. The use of aqueous extract of *Garcinia cambogia* fruit at 1% level was optimum for the room temperature preservation of the pork fry for about six days.

Key words: *Garcinia cambogia*, fruit extract, pork fry, shelf life, room temperature

INTRODUCTION

The problem of food preservation has become more complex with the frequent introduction of new food products to the market, requiring a longer shelf-life. Today, consumers tend to buy ready to eat meat products that are nutritious as well as tasty. Further, awareness about food safety and health has prompted them to prefer minimal processed and naturally preserved products. Therefore, the last decade has witnessed a widespread research on natural preservatives. These include herbs, plants, fruits, vegetables and their extracts or powders that possess antioxidant and antimicrobial properties. The antioxidant effects of curry leaf powder (Biswas *et al*., 2012; Najeeb, 2013), pomegranate fruit by-product powders (Devatkal and Naveena, 2010), rosemary with tea catechins (O'Grady *et al*., 2006) have been investigated for their use in meat products. A recent patent granted to Tyson Foods, Inc. (Baublitis and Sawyer, 2011) describes the use of celery

powder for surface application on fresh meat that is packaged in vacuum or in low-oxygen modified atmosphere. The current food industry aims at reducing economic losses due to reduced shelf-life of the products. But, the major challenge includes avoiding transmission of food borne diseases while catering to the consumer demands for quality. Among the herbs and spices used as natural preservatives in various food products, scientific reports on *Garcinia cambogia* fruit extract as a biopreservative in meat are scanty.

Garcinia belongs to the family Guttiferae, which includes 200 tropical species distributed in tropical Asia, Africa and Polynesia. India has about 30 species of *Garcinia* that grow in the rain forests of Western Ghats region covering Mysore, Coorg and Wynaad. Of these, *Garcinia gummi-gutta* and *G. indica* (kokum) are distributed in the Central Western Ghat region of Karnataka. *Garcinia indica* is synonymous with *Garcinia purpurea* and is known as *Murugal* in Kannada, *Brindon* in Goa, *Bhirind* or *Ansul* in Marathi and Konkan (Sullivan *et al*., 1974).

In Southeast Asia and Southern India, dried rinds of *G. cambogia* are used as a flavoring agent, carminative and preservative in certain dishes. Especially in Southern India they are valued as a condiment, in place of tamarind or lemon, for flavoring curries, meat and seafood dishes. The fruit has also been used for centuries to make meals more 'filling' (Sergio, 1988). *G. cambogia* fruit rinds were reported to be used in the preservation of fish (Sreenivasan and Venkataraman, 1959; Clouatre and Rosenbaum, 1994) which is commercially called "Colombo curing" (Sreenivasan and Venkataraman, 1959; Lewis *et al*., 1964).

A polyisoprenylated benzophenone, *garcinol*, is present in Guttiferae (Krishnamurthy *et al*., 1981). Hydroxycitric acid is found in the fruit rinds of *G. cambogia*, *G. indica* (Jayaprakasha and Sakariah, 1998, 2002) and *G. cowa* (Jena *et al*., 2002). The antimicrobial and antioxidant properties of *Garcinia* were reported to be due to the secondary metabolic compounds. These include xanthones, lactones, flavonoids, phenolic acids and benzophenones (Gustafson *et al*., 1992). In regions of Coorg district in Karnataka, this extract of *Garcinia cambogia* fruit is used in the famous, relished pork curry (pandhi curry), the flavor and acceptability of which remains high even with increased storage period. Keeping these points in view, the present study was undertaken to evaluate the efficacy of the extract of this fruit in extending the keeping quality of pork fry at room temperature.

MATERIALS AND METHODS

Preparation of pork fry: Pork required for the experiments were procured from the Department of Livestock Products Technology, Rajiv Gandhi Institute of Veterinary Education and Research (RIVER), Pondicherry, India after the hygienic slaughter of a Large White Yorkshire pig. After deboning and separation of fat, the meat from the loin region of the carcass was cut into uniform pieces of 1 cm^3 and stored at -18°C. The frozen pork cubes were thawed overnight at 6°C. After thawing, it was marinated as per recipe (Table 1) and kept in a refrigerator at 4±1°C for 1 h.

Table 1: Recipe for preparation of pork fry

Ingredients	Control (%)	Treatment 1 (%)	Treatment 2 (%)
Meat	100	100.00	100.00
Salt	1.75	1.75	1.75
Dry spice mix	2	2.00	2.00
Green condiments	5	5.00	5.00
Oil	10	10.00	10.00
G. cambogia fruit extract	---	1.00	2.00

During the preparation of the pork fry, oil was heated in a pan and the green condiments (onion, garlic and ginger:3:1:1) were added at 5% level and fried until golden brown color developed. The marinated meat was added and shallow fried along with dry spice mix (added at 2% level) with intermittent stirring for about 45 min. The aqueous extract of *Garcinia cambogia* fruit was added at levels of 1 and 2% to the treatments 1 and 2, respectively. This was accompanied by heating for a minute followed by stirring for proper mixing. A control sample was prepared following the same method except the addition of the extract. The final moisture content in all the products was 46%. All three products were cooled, packed in sterilized glass bottles and stored at room temperature for further physico-chemical, sensory and microbiological analyses.

Evaluation of the product during storage: The pH of the products were recorded by homogenizing 5 g of meat sample in 45 mL of distilled water, using a combined electrode of a digital pH meter (ELICO-LI 120). The moisture content of the pork fry was determined as per standard analytical procedure (AOAC, 2000) and expressed as percent. TBARS (Thiobarbituric acid reacting substances) value of the samples were assessed by distillation method following the procedure outlined by Tarladgis *et al.* (1960). Tyrosine values were estimated adopting the procedure of Strange *et al.* (1977) with minor modifications. The microbial quality of the samples was assessed by determining the standard plate count (SPC) following procedures recommended by APHA (1984) using plate count agar (Hi-Media, Mumbai) during storage of the products at room temperature. The control and treated samples of pork fry were evaluated for changes in quality at periodic intervals of 0, 3 and 6 days. A semi-trained panel consisting of faculty and post-graduate students of Rajiv Gandhi Institute of Veterinary Education and Research, were used for organoleptic evaluation of the product on a 8 point hedonic scale (where, 8 = like extremely, 1 = dislike extremely) for attributes viz. appearance, flavour, juiciness, texture and overall acceptability (Keeton, 1983). The samples were analyzed in duplicates and the experiment was replicated thrice. Data generated were analyzed using SPSS version 16.0 MSI of windows (SPSS, Chicago, USA) and levels of significance were calculated following the Least Significant Difference Test (Snedecor and William, 1967).

RESULTS AND DISCUSSION

The data on the physico-chemical, microbial and organoleptic properties of the control and treated samples of pork fry are presented in Table 2 and 3. Perusal of data revealed that the addition of the aqueous extract of *Garcinia cambogia* fruit to the pork fry resulted in a significant ($p<0.05$) decrease in pH as the level of extract was increased. Treatment 2 had the lowest pH at the end of 6th day of storage 5.12 whereas control had the highest pH of 6.0. This might be due to the acidic nature of the extract causing a lower pH in the treated samples.

The TBARS and tyrosine values of the pork fry in the treatment 1 (1.65 and 5.57 mg kg^{-1}) were also lower than that of the control (1.94 and 6.73 mg kg^{-1}). TBARS numbers in samples of treatment 1 was the lowest on the 6th day (1.86 mg kg^{-1}). Control and treatment 2 showed higher values of 2.27 and 3.22 mg kg^{-1}, respectively. The major acid in the fruit of *G. cambogia* was identified as hydroxycitric acid (Lewis and Neelakantan, 1965; Lewis, 1969). The plant also contains hydroxycitric acid lactone, but in minor quantities (Jayaprakasha and Sakariah, 2002). These, along with the aldehydes present in the extract might be responsible for the higher TBARS (mg malonaldehyde kg^{-1}) value.

Table 2: Effect of *Garcinia cambogia* extract on the quality of pork fry stored under room temperature

Parameters	Treatments	Day 1	Day 3	Day 6
pH	Control	5.84 ± 0.080^{C}	5.93 ± 0.090^{C}	6.00 ± 0.070^{C}
	T 1	5.32 ± 0.030^{B}	5.41 ± 0.070^{B}	5.56 ± 0.140^{B}
	T 2	5.10 ± 0.060^{A}	5.11 ± 0.080^{A}	5.12 ± 0.120^{A}
TBA (mg kg^{-1})	Control	1.94 ± 0.230^{A}	2.12 ± 0.261^{A}	2.27 ± 0.300^{A}
	T 1	1.65 ± 0.245^{B}	1.79 ± 0.330^{A}	1.86 ± 0.216^{A}
	T 2	2.89 ± 0.240^{B}	2.97 ± 0.248^{B}	3.22 ± 0.302^{B}
Tyrosine (mg kg^{-1})	Control	6.73 ± 0.590^{cA}	7.51 ± 0.715^{bA}	8.45 ± 0.501^{aA}
	T 1	5.57 ± 0.643^{cA}	7.36 ± 0.585^{bA}	8.39 ± 0.711^{aA}
	T 2	8.20 ± 0.585^{cB}	8.70 ± 0.601^{bB}	10.96 ± 0.610^{aB}
Standard plate count (log CFU g^{-1})	Control	2.13 ± 0.070^{aC}	4.34 ± 0.070^{bC}	4.92 ± 0.060^{cC}
	T 1	1.93 ± 0.060^{aA}	3.01 ± 0.060^{bA}	3.84 ± 0.070^{cA}
	T 2	1.61 ± 0.070^{aB}	3.85 ± 0.070^{bB}	4.06 ± 0.060^{cB}

Means with different superscripts (capital letters in the same column and small letters in the same row) differ significantly ($p< 0.05$), T1: 1% aqueous extract of *Garcinia cambogia* fruit, T2: 2% aqueous extract of *Garcinia cambogia* fruit, ND: Not done

Table 3: Effect of *Garcinia cambogia* fruit extract on the sensory quality of pork fry stored under room temperature

Parameters	Treatments	Day 1	Day 3	Day 6
Appearance	Control	7.18±0.240	ND	ND
	T 1	7.00±0.240	7.18±0.23	7.01±0.24
	T 2	7.18±0.230	7.18±0.24	6.90±0.23
Flavor	Control	7.27 ± 0.170^{bB}	ND	ND
	T 1	7.27 ± 0.180^{bB}	6.90 ± 0.17^{aB}	6.81 ± 0.17^{aB}
	T 2	6.545 ± 0.18^{bA}	6.27 ± 0.18^{aA}	6.09 ± 0.17^{aA}
Texture	Control	7.18 ± 0.13^{bB}	ND	ND
	T 1	6.18 ± 0.13^{bA}	6.18 ± 0.14^{aA}	6.09 ± 0.13^{aA}
	T 2	6.27 ± 0.14^{bA}	6.18 ± 0.12^{aA}	6.0 ± 0.11^{aA}
Juiciness	Control	7.18 ± 0.17^{bB}	ND	ND
	T 1	6.72 ± 0.18^{bA}	6.54 ± 0.13^{aA}	6.27 ± 0.15^{aA}
	T 2	6.81 ± 0.21^{bA}	6.27 ± 0.16^{aA}	6.09 ± 0.20^{aA}
Overall acceptability	Control	6.63 ± 0.17^{b}	ND	ND
	T 1	6.90 ± 0.16^{b}	6.63 ± 0.15^{a}	6.36 ± 0.15^{a}
	T 2	6.72 ± 0.21^{b}	6.36 ± 0.36^{a}	6.18 ± 0.14^{a}

Means with different superscripts (capital letters in the same column and small letters in the same row) differ significantly ($p<0.05$), T1: 1% aqueous extract of *Garcinia cambogia* fruit, T2: 2% aqueous extract of *Garcinia cambogia* fruit, ND: Not done

Tyrosine value increases during storage but the increase is more evident with advanced spoilage than the changes occurring during early stages of spoilage (Pearson, 1968). Lea *et al.* (1969) stated that in addition to tyrosine, the value also measures the group of products produced due to microbial action like tryptophan, cysteine, phenolic groups, sulphydryl compounds, hydrogen sulphide etc. The higher tyrosine values in case of treatment 2 may be owing to the bioflavonoids (a class of polyphenolic compounds) in the fruit extract (Cadenas and Packer, 1996; Peter, 2001; Rastogi and Nayak, 2010; Yoshikawa *et al.*, 2000).

Najeeb (2013) observed higher tyrosine values for restructured chicken slices incorporated with gooseberry powder which might be attributed due to the presence of extremely high polyphenolic contents of gooseberry (24.5±1.11 g Gallic Acid Equivalent/100 g) similar to that reported by Mishra *et al.* (2009). There was an increase in both TBARS and tyrosine values with the increase in storage period and both the treatments significantly ($p<0.05$) differed from control. However, from the sensory point of view, both the treatments were well within the acceptable range.

Standard plate count showed significant ($p<0.05$) differences between the control and the treatment groups and days of storage. On day 1, there was a significant ($p<0.05$) reduction in the SPC in treated samples compared to control indicating that the extract had exerted antimicrobial activity on the treated samples. Thereafter SPC increased gradually with the increase in storage period for all the control and treated samples which ranged from 1.6 to 4.92 log CFU g^{-1}. However, treatment 1 showed the lowest microbial load on day 6 (3.84 log CFU g^{-1}). Both the treated samples had microbial counts within acceptable limit on the sixth day of ambient temperature storage.

Sensory data (Table 3) revealed that the appearance scores of all the products remained above 7 on the 8 point hedonic scale. There were no significant ($p<0.05$) differences in appearance for all the groups. In terms of flavor, both treatment 1 and 2 were acceptable. But samples of treatment 2 had significantly ($p<0.05$) lower scores throughout the study and samples belonging to treatment 1 were more preferred. This might be due to a slight bitterness imparted to the product as the level of the extract increased in the product. Texture and juiciness scores for all the products were in the range of 6 to 7. However, the texture and juiciness scores for the treatments were significantly ($p<0.05$) lower than the control on day 1. This may be because of the hard nature of the products due to reducing moisture by frying and the low pH of these products leading to reduction in water holding capacity, hence, the lowering of juiciness. The decline in pH can cause protein denaturation resulting in additional loss of water-holding capacity (Offer, 1991). The overall acceptability varied significantly ($p<0.05$) for control and treatments with the increase in days of storage. However, control became unacceptable for sensory evaluation due to off odour after 48 h of preparation. Among the treatments, treatment 1 proved to be more acceptable than treatment 2.

CONCLUSION

From the observations recorded in the present study, it can be concluded that the pork fry treated with 1% aqueous extract of *Garcinia cambogia* fruit has the best physico-chemical properties, is microbiologically safe and has the best sensory attributes. Hence, its addition at the rate of 1% can be considered to be most effective for use as a bio-preservative in pork fry with a shelf life up to six days under room temperature.

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