Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), vol 12(2), 2024
http://dx.doi.org/10.7770/safer-V13N1-art546

Utilization of red banana peel as a functional ingredient in beef patties

Uso de la cáscara de plátano rojo como ingrediente funcional en hamburguesas de vacuno

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ABSTRACT

The study was conducted to develop a functional meat product from beef in the form of patties by the incorporation of the peel of red banana (Musa acuminata) (Chenkathali) as antioxidant and functional ingredient. In the study, the selected functional sources viz. red banana peel was incorporated at different levels as 0, 2.5, 5, 7.5, and 10% by weight of the emulsion, in the formulation of pre-standardized beef patties. Shelf life studies were conducted during the intervals 0^{th}, 2^{nd},4^{th} and 6^{th} days. Results showed that red banana peel had the ability to reduce TBARS and Tyrosine values which indicates as reduced lipid oxidation and protein degradation. Sensory evaluation indicated good acceptable patties with acceptable attributes. The sensory and physico-chemical properties, beef patties incorporated with 7.5 % red banana peel were comparable to control and it was adjudged as the optimum level for incorporation as a source of dietary fibre and functional source.

Keywords: Patties, Antioxidant, TBARS, Tyrosine

RESUMEN

El estudio se realizó para desarrollar un producto cárnico funcional a partir de la carne de vacuno en forma de hamburguesas mediante la incorporación de la cáscara de plátano rojo (Musa acuminata) (Chenkathali) como ingrediente antioxidante y funcional. El ingrediente funcional seleccionado en el estudio fue la cáscara de plátano rojo, que se incorporó en distintos niveles: 0; 2,5; 5; 7,5; y 10% por peso de emulsión en la formulación de hamburguesas de vacuno pre estandarizadas. Los estudios de conservación de alimentos se realizaron durante los intervalos de día cero, segundo, cuarto y sexto. Los resultados demostraron que la cáscara de plátano rojo tiene la capacidad de reducir los valores de TBA y tirosina, lo que indica una reducción de oxidación de lípidos y degradación de proteínas. La evaluación sensorial indicó que las hamburguesas eran buenas y aceptables al igual que sus atributos. Las propiedades sensoriales y fisicoquímicas demostraron que las hamburguesas de vacuno elaboradas con un 7,5% de cáscara de plátano rojo eran comparables al control y se consideraron a nivel óptimo para la incorporación como fuente de fibra dietética e ingrediente funcional.

Palabras clave: hamburguesas, antioxidante, TBA, tirosina

INTRODUCTION

Kumar et al., (2012) developed phenolic extracts from banana peels (Musa acuminata Colla AAA) and cinnamon barks (Cinnamomum varum) and studied their antioxidative potentials in fish oil. Banana fruits contain high levels of phenolic compounds, especially in the peel, which can contain three to five times more tannin than the pulp (Pareek, 2016). Tannins are perhaps the most important phenolic from the point of view of fruit and in bananas, most carotenoids are in the peel with generally low amounts in the pulp (Pareek, 2016). Gonzalez et al. (2009) studied on antioxidant activity in banana peel extracts (Musa acuminata) and reported that it contained large amounts of dopamine, L-dopa and catecholamines with a significant antioxidant activity. On an average one banana contains 15% of the vitamin C, 11% of the potassium and 16% of the dietary fiber needed each day for good health (Rajoriya, 2011). They also offer a number of health benefits such as, strengthens immune system, relieves heart health, improves eye and skin health, alleviates digestive problems and helps combat smoking (Rajoriya, 2011). Among eight banana varieties viz., Dwarf Cavendish, Rubusta, Rasthali, Poovan, Nendran, Hill Banana, Red Banana, Karpooravalli. Red Banana ranked highest in total carotenoid contents for pulp and beta-carotene was estimated to be the highest in the case of and in pulp. The peels of cultivars Red Banana and Karpooravalli are rich source of bioactive compounds, such as carotenoids (beta-carotene), antioxidative enzymes and carbohydrate contents. The Red Banana ranked highest in total carotenoid contents for pulp and second highest in the case of peels. However, betacarotene was estimated to be the highest in Red Banana both in the case of peels and pulp (Arora et al., 2008). Oral administration of the ethanol extract of fruits of Musa AAA (Chenkadali) significantly decreased the levels of serum triacylglycerol, cholesterol and alanine amino transferase activity. Ripe fruits of Chenkadali are used in variety of ayurvedic preparations due to its medicinal properties. Ethanol extract of mature green fruits of Musa AAA (Chenkadali) has antioxidant and hypolipidaemic properties and may be used for treating diabetes mellitus (Kaimal et al. 2009).

MATERIALS AND METHODS

Preparation of beef patties: Control and treatment beef patties were prepared using ingredients as shown in Table 1. Meat was minced twice through 6 mm diameter grinder plate in a meat mincer (Sirman, Italy). Minced meat was chopped with ice, salt, sodium tripolyphosphate (STPP), sunflower oil, binders (wheat flour and soy flour), condiments and spices to form the emulsion in a bowl chopper (Talsa -TC12E, Spain). The batter was collected after chopping and separated into five equal batches and each batch except control was mixed with ground red banana peel in different combinations. The well mixed batter was molded into proper round flat shapes and oven cooked for 20 minutes at 160^{o}C. Cooked beef patties after cooling, were packed in Low density polyethylene films (200 gauge) and sealed. The formulated patties were as follows: C without banana peel, T1 with 2.5% banana peel by weight, T2 with 5% banana peel by weight, T3 with 7.5% banana peel by weight, T4 with 10% banana peel by weight were stored under refrigerated conditions (0±4°C) for storage studies. The beef patties were analyzed for physical, physico-chemical and sensory characteristics on days 0, 2, 4, and 6 or until spoilage whichever is earlier.

Physico-chemical parameters.

Cooking yield: Weights of batter of each batch before and after oven cooking were recorded. The percentage of cooking yield was assessed as the ratio of final weight to initial weight.

Table 1

Ingredients.	C	T1	T2	T3	T4
Beef	1 kg	1kg	1kg	1kg	1kg
Oil	150g	150g	150g	150g	150g
Ice	180g	180g	180g	180g	180g
Wheat flour	30g	30g	30g	30g	30g
Soy flour	30g	30g	30g	30g	30g
Onion	30g	30g	30g	30g	30g
Garlic	20g	20g	20g	20g	20g
Ginger	9g	9g	9g	9g	9g
Salt	15g	15g	15g	15g	15g
STPP	6g	6g	6g	6g	6g
Spice mix	19.5g	19.5g	19.5g	19.5g	19.5g
Banana peel	0%	2.5%	5%	7.5%	10%

pH: pH of the samples was measured using a digital pH meter as described by AOAC (1990). Ten grams of sample was blended with 50 ml distilled water for one min. The pH of the homogenate was recorded by immersing the combined glass electrode of a digital pH meter (EUTECH instruments pH 510, Singapore).

Thiobarbituric acid reactive substances (TBARS) number.

TBARS values were determined as per Witte et al. (1970) with modifications. Accurately weighed 20 g sample was blended with 50ml chilled extracting solution containing 20 per cent trichloroacetic acid in 2 M orthophosphoricacid for 1.5 to 2 min. The resultant slurry was made up to 100ml with deionized distilled water. This solution was filtered through Whatman No.1 filter paper. From the filtrate, 5ml was transferred to a screw capped vial followed by 5ml of 2-thiobarbituric acid solution (0.005M in distilled water). The solution was mixed by inverting the vial and kept for 15 h in darkness at room temperature. The absorbance was determined at 530nm against blank containing 5ml of distilled water and 5ml 2-thiobarbituric acid solution in a spectrophotometer (UV/VIS Lambda 25,

Perkin Elmer, Singapore). The absorbance was converted to TBARS value and was expressed as TBARS number of sample.

Tyrosine value: Tyrosine values of the beef patty samples were estimated as per the method described by Pearson (1968). To accurately weighed 2g of sample, 40 ml of 5 percent trichloroaceticacid solution (TCA) was added. After homogenization for 2 min the samples were filtered. The filtrates of TCA extracts were used in the estimation of tyrosine value. To 2.5 ml of TCA extract in a test tube, equal quantity of distilled water and 10 ml of 0.5 N sodium hydroxide were added and shaken. Three milliliters of diluted Folin-Ciocalteu's phenol (FC) reagent (1 ml of concentrated FC reagent and 2 ml of distilled water), were added, mixed and the contents were allowed to stand for 5 min at room temperature. The absorbances were measured at 660 nm in a spectrophotometer (UV/VIS Lambda 25, Perkin Elmer, Singapore) with a blank. By referring to the standard graph of tyrosine, tyrosine values of samples were calculated and expressed as mg of tyrosine/100g of sample.

Standard graph for tyrosine value: Accurately weighed 0.10 g of tyrosine was dissolved in 5 percent TCA in a 500 ml volumetric flask and made up to the mark with double distilled water. The following volumes of tyrosine solution were added to a series of 100 ml volumetric flask: 0, 1, 3, 5, 7, 10, 12, 15, 20 ml. Each was made up to the mark with double distilled water and mixed thoroughly. Five milliliter of each solution was mixed thoroughly with 10 ml of 0.5 N sodium hydroxide solution and 3.0 ml of diluted Folin Ciocalteu's (FC) reagent and then treated as described above. The standard graph was prepared by plotting optical density against mg of tyrosine dissolved in trichloroacetic acid solution.

Hunter lab colour: Colour of the ready to eat beef patty samples were determined objectively as per Page et al. (2001) using Hunter Lab Mini Scan XE Plus Spectrophotometer (Hunter Lab, Virginia, USA) with diffuse illumination. The instrument was set to measure Hunter L, a and b using illuminant 45/0 and 10^{o} standard observer with an aperture size of 2.54 cm.

Sensory attributes: Sensory evaluation of beef patties was conducted by a semi-trained using an eight-point Hedonic score card as for appearance, flavour, juiciness, texture, binding, saltiness and overall acceptability. Uniform samples of each category of patties were taken and heated in an oven for 10 minutes. The warm patties were served to the panelists with code number and score card, and asked to rate in the eight-point Hedonic scale (Badret al., 2004).

Statistical analysis: The data generated from various trials under each experiment were pooled and analyzed by statistical method of one way-ANOVA and Mean±S.E using SPSS Statistics 25.0 software package developed as per the procedure of Snedecor and Cochran (1995) and means were compared by using Dunkan's multiple range test (Dunkan, 1995).

RESULTS AND DISCUSSIONS

As an optimum level of treatment T3 with 7.5% peel incorporation was selected for further study (mentioned as 'treatment' from hereby) by considering all the quality parameters such as sensory properties, chemical composition, dietary fibre content, antioxidant activity etc. The shelf life study of cooked functional beef patties was conducted under refrigerated storage (4±1°C) and various parameters were analyzed on days 0, 2, 4, and 6.

Cooking yield: A trend of slight gradual decrease in cooking yield could be seen in the patties as the level of peel incorporation increases. Maximum yield was detected in the control samples (94.03 %). Lowest cooking yield was found in T4 with 10% level of peel incorporation (90.68 %). The decrease in cooking yield could be attributed to the loss of additional moisture contributed by the ground banana peels which increases with the level of incorporation.

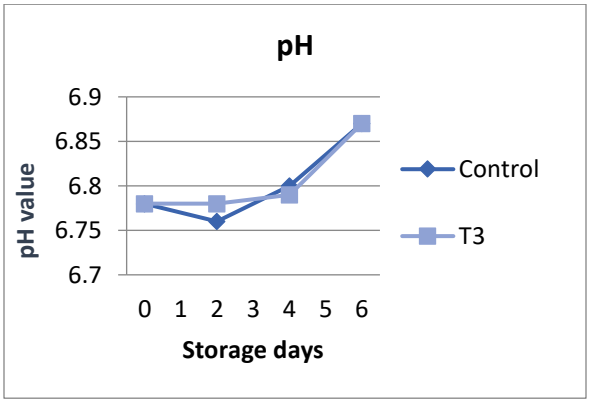

Fig 1. pH value of control and treatment patties during storage

pH: There was no significant relation between pH and the treatment patties when compared to the control. This indicates that no acidic compounds were produced by the red banana peel into the patties other than that already present during refrigerated storage. Bilek et al., (2009) reported similar observation in beef patties incorporated with flaxseed flour (Fig. 1).

TBARS value: In both control and treatment patties, TBARS value increased with increase in storage days. But in the case of treatment patties the increase was much slower and significantly lower from that of control. From the graph it could be seen that the increase in TBARS value of treatment patties was lower and less steep than that of control. From the statistical analysis it could be seen that the values of treatment patties and control are not comparable except on day 6. This indicates that red banana peel incorporation reduces lipid oxidation during the storage of cooked beef patties. Kumar et al., (2012) also reported a similar effect of banana peel extract on fish oil. Hawashin et al., (2016) noted similar observations in functional beef patties incorporated with olive cake powder (Fig. 2).

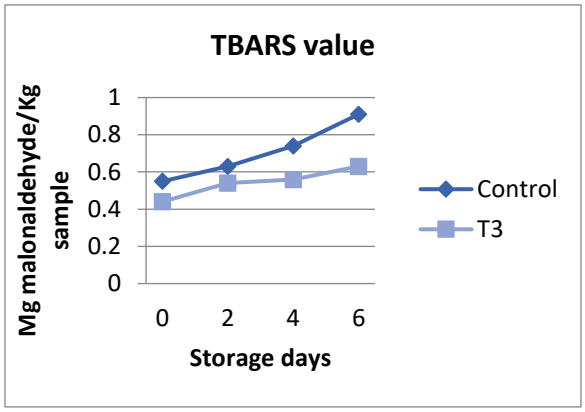

Fig. 2 TBARS value of control and treatment patties during storage

Tyrosine value: Significant difference could be seen between control and treatment patties during the storage period in the case of protein degradation. From day 0 to day 6, the tyrosine value increased in both samples but in the case of treatment patties the increase was slower and less steep with lower values than control. This indicates that red banana peel could be used as a functional ingredient in beef patties that could reduce protein degradation. Ganhao et al., (2010) made a similar study on protein oxidation in emulsified cooked burger patties with added fruit extracts and reported positive results (Fig. 3).

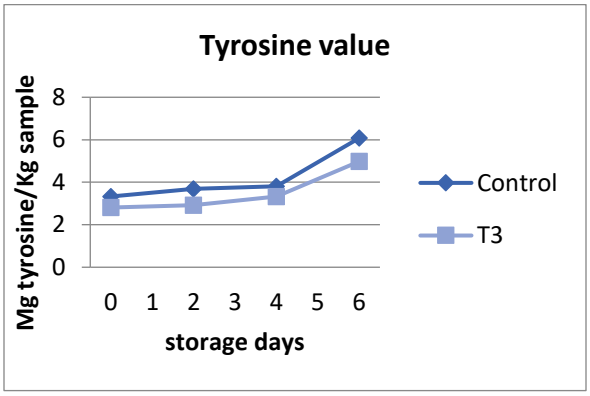

Fig. 3 Tyrosine value of control and treatment patties during storage

Colour parameters: Hunter colour (L*, a*, b*) values of both control and treatment patties were evaluated during the storage period of 0 to 6 days.

'L*' value: From the results it could be seen that on day 0 peel incorporation negatively affects the colour of beef patties by decreasing the lightness. Interestingly as the storage period increases it could be seen that the L* value of treatment patties gradually increases and reaches to a similar value that of control patties on day 6. This indicates that the lightness lost on the first day of production is retained to certain extend during storage or in other words red banana peel reduces color deterioration in treatment patties when compared to control (Fig. 4).

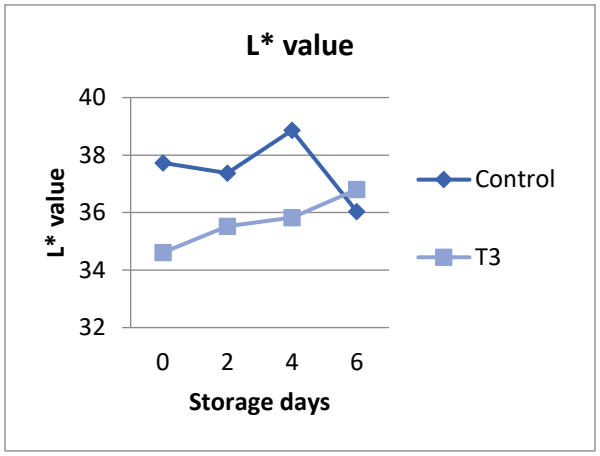

Fig. 4. L* value of control and treatment patties during storage

'a*' value. When comparing to control, treatment patties showed significantly reduced 'a*' values. This indicates that redness of patties were reduced with incorporation of red banana peel. Also a decreasing trend could be seen in the 'a*' values of treatment patties and in control patties but in control this decrease was steeper and fast. Shelf life study indicated that cooked beef patties both control and treatment patties losses its redness upon storage.

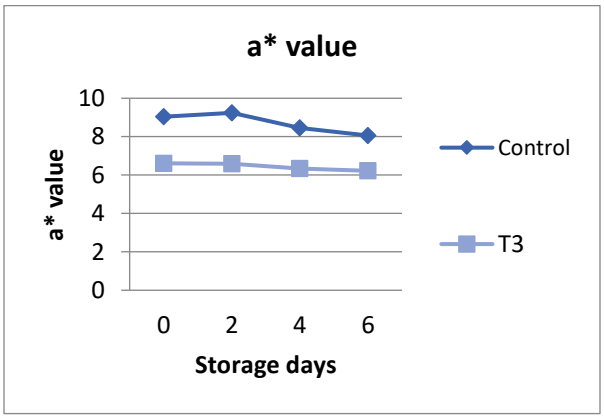

Fig. 5. a* value of control and treatment patties during storage

'b*' value: An increasing trend could be seen in the 'b*' values of both control and treatment patties. In the case of treatment patties, it could be seen that the values were significantly lower than that of control which indicates reduced yellowness. However, the increasing trend was almost similar in both when comparing on the graph. The overall values indicate that red banana peel incorporation decreases 'b*' value of cooked beef patties but the values gradually increase upon refrigerated storage in both control and treatment patties.

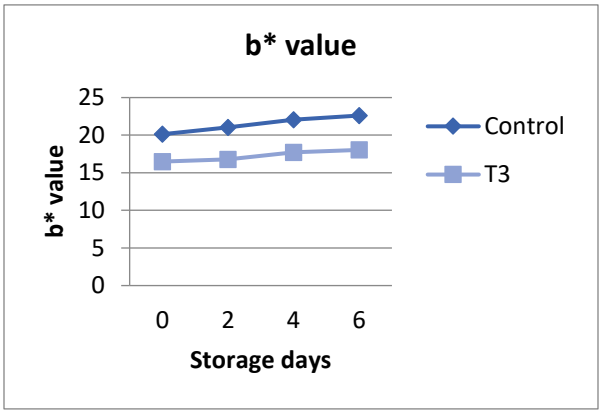

Fig. 6. b* value of control and treatment patties during storage

In contrast to this Devatkal et al., (2014) reported that during refrigerated storage period, all colour parameters decreased significantly in all treatments (banana and sapodilla peel extract) of raw poultry. Garrido et al. (2011) applied redgrape (Vitis vinifera var. Monastrell, Murcia, Spain) pomace to pork burgers and reported that results showed colour stability improvements. Kim et al., (2013) applied Broccoli (Brassia oleracea L.) powder extract in ground beef patties and reported that treatments showed significantly better colour stability than those without antioxidants.

Sensory attributes: All the scores were found acceptable and good. There were no hedonic scores found categorizing the treatments unacceptable (Fig. 7).

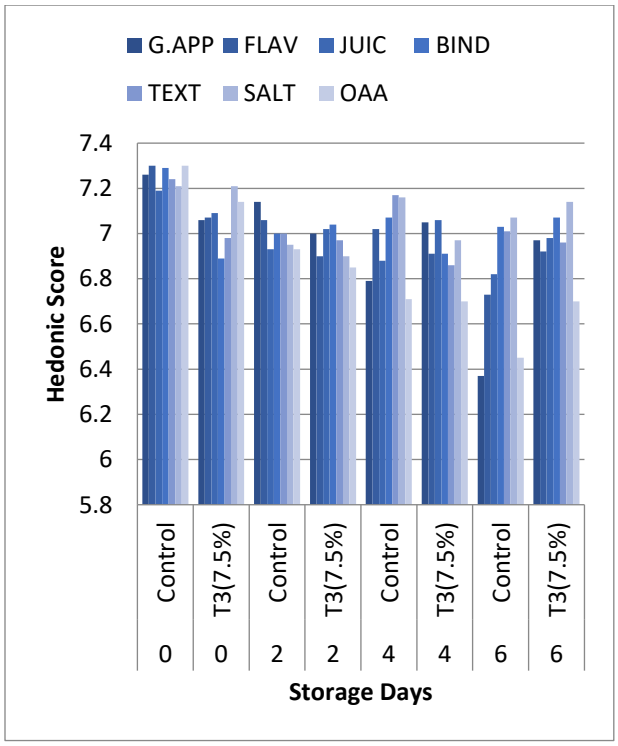

Fig. 7. Sensory properties of control and treatment patties during storage

General appearance: Both control and treatment patties seem to be decreasing general appearance score on storage period. In the case of control patties, the decrease was faster and steeper compared to treatment patties which had slower reduction in scores.

Flavour: Similarly, treatment patties retained more flavour properties than control patties at the end of day 6. The reduction in flavour scores were less steep and slow in treatment patties compared to control which had a higher rate of reduction.

Juiciness: Treatment patties had lower score than control on first day but from 2nd day onwards treatment patties showed higher values than control till 6th day. The reduction in juiciness value of T3 was slower and less steep compared to control. It indicates that on storage treatment patties had better juiciness than control.

Binding: On day 6, treatment patties had better binding properties than control patties. Control samples showed an overall decrease in binding scores but in the case of treatment patties the scores increased from day 0 to day 6.

Texture: On all the days of analysis during the storage period treatment patties showed a lower texture property than control samples. Both control and treatment patties showed a decrease in texture score but in the case of control the decrease was faster than treatment patties.

Saltiness: From day 0 to day 6 both control and treatment patties showed a decrease in saltiness values but at the end of 6th day treatment patties had higher score than control.

Overall acceptability: Both control and treatment patties showed a gradual decrease in overall acceptability scores. In the case of treatment patties, the decrease trend was slow and less steep than that of control. On day 6, treatment patties had higher acceptability score than control which indicates that addition of banana peel improves sensory properties of the patties.

SUMMARY AND CONCLUSION

From the current study it could be concluded that the addition of red banana peel into beef patties emulsion had its positive effects of inhibiting both lipid and protein degradation and could be utilized as a functional ingredient to beef patties. From TBARS and Tyrosine values, it is evident that red banana peel contained bioactive compounds mainly antioxidants that could prevent oxidation and extend the storage qualities of the product. In the case of T3 and control patties both L* and b* values seem to be increasing with storage but ‘a*’ value was seen decreasing. Contrasting reports have been made in terms of colour parameter which depends on the type of fruit extract used as the functional ingredient. Sensory evaluation even though the sensory scores decreased in both control and T3, the reduction was faster and steeper in control than in T3 which had lower rate of decrement.

It could be concluded that red banana peel could impart antioxidant properties, sensory attributes, dietary fibre, minerals and nutrient enhancement in patties if incorporated at proper levels.

ACKNOWLEDGEMENTS

I express my heartfelt thanks to Dr. Irshad A (Assistant Professor, Meat Technology Unit, KVASU) who guided me through the entire work. I express my gratitude towards all the members of Department of Meat Technology, KVASU. Last but not least I thank my seniors and friends for their guidance.

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Received: 09th August 2021; Accepted: 17th January 2023; First distribution: 25th April 2023