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Study of quality & antioxidant properties of green tea doughnut

Sushma Kumari, John Diamond Raj and RN Shukla

Abstract
This study investigated the influence of green tea powder on the nutritional properties of doughnut during storage period. The doughnut prepared by the incorporation of green tea powder in concentrations of 0%, 5% 10% and 15% as 0g, 5g, 10g and 15g of green tea powder. Respectively and stored for six days. The physicochemical, antioxidant and sensory analysis were performed on 0th, 3rd and 6th day of storage period. It was found that moisture content of 15% green tea doughnut was lowest 67.95 % on 0th day among the other three green tea doughnuts and increased with storage periods. The fat content of 15% was highest 9.12 compared to other and increased on storage whereas ash content of 5% was found highest and on storage it was decreased. By DPPH assay, highest antioxidant activity was found in 15% and decreased with increasing storage day. Total phenolic content was also found highest in 15% and storage had decreased the total phenolic content. By sensory analysis it was observed that doughnut of treatment 10% containing best in taste and flavor.

Keywords: doughnut, green tea, physicochemical analysis, antioxidant analysis, sensory analysis, dpph, total phenolic content

1. Introduction
The bakery industry continues growing around the world. Doughnuts are usually deep fried from flour dough and typically either ring shaped or a number of shape without a hole and often filled but can also be ball shaped (the "hole"). Wheat dough, as the intermediate material, is the transformation of the wheat flour, water and other ingredients that has been used for making biscuits, bread, cookies and doughnut (Mohamed *et al*., 1998) [9].
The most common type is the ring doughnut and the filled doughnut, which is injected with fruit preserves, cream custard or other sweet filling. Alternatively, small pieces of dough are sometimes cooked as doughnut hole. Once fried, the doughnut may be glazed with a sugar icing spread with icing or chocolate on top, or topped with powdered sugar or sprinkles, or fruits other shapes including ring, ball, flattened spheres, twists and other forms doughnut varieties are also divided in to cake (including the old fashioned) and yeast risen type doughnut (Michalska *et al*., 2007) [8].
Tea has even used for centuries by ancient cultures for its medicinal properties and is popularly consumed in unfermented (green tea), semi fermented (oolong) and fermented (black tea) forms. Black tea is commonly consumed in the West whereas the consumption of oolong is high in China and Japan (Higdon and Frei 2003) [5]. Green tea is especially popular in Asia, mainly for its health benefits. Several studies have reported that green tea extract has antioxidant, antibacterial, antiviral, anticarcinogenic, and antimutagenic functions such as the bioactive molecules of green tea extract has been studied by using ethyl lactate and indicated the antioxidative effect of green tea.
In order to incorporate green tea in different foods, it should be used as a powder, because powder is easier to enter in to the structure of food. Whereas, at present, the incorporation of green tea powder in different foods is very limited and not much work has been reported on the effect of green tea powder on wheat flour and doughnut properties.

2. Materials and Methods
This chapter deals with the description of various materials and methods used to accomplish the experimental work.

2.1 Procurement of Raw materials used
Refined wheat flour, sugar, eggs, butter, green tea powder and vanilla essence were bought from local market of Allahabad.

2.2 Preparation of value added green tea doughnut
An ingredient for preparation of doughnut was collected. Creaming of shortening and green tea was performed in a separate vessel. An egg was beaten with the help of blender. This mix was transferred into the creaming mixture. Flour was added alternately and mixed gently. Mixing was performed in a single direction (clockwise) with help of blender until the appearance of bubbles. Greasing of the doughnut maker was done with the help of butter oil. The mix was poured into the doughnut maker with the help of stainless steel spoon. Then doughnut was baked at 180˚C for 10 min.

2.3 Physico-chemical analysis
2.3.1 Determination of fat content was done by soxhlet method (Ranganna, 1986) [11]
2.3.2 Determination of pH was done by ph meter.
2.3.3 Determination of doughnut volume
A 2000 ml cylinder was filled with 600 ml of sunflower oil, 4 doughnuts were weighed and immersed in the oil. Volume of oil with doughnut was checked. The density of doughnut (V_{100} ml. $100g^{-1}$) was calculated and then volume was calculated with the use of a formula.

$$V = \frac{m}{V_{100\ ml.\ 100\ g^{-1}}} \quad \text{……..eq (2.1)}$$

Where,
$V_{100ml.100g}^{-1}$ = v (total volume of oil and doughnut) - 600
m = weight of 4 doughnuts

2.3.4 Determination of ash content was done by Muffle furnace (By Ranganna, 1986) [11]
2.3.5 Determination of moisture content was done by hot air oven (AOAC, 1995)
2.3.6 Determination of Total Phenolic Content (TPC) was determined by using Folin-Ciocalteu's reagent (Singleton *et al*., 1999) [12].
2.3.7 Determination of free radical scavenging activity by DPPH assay was done according to Hatano *et al*. (1988) [4].

2.4 Sensory analysis
Sensory analysis was done by 9 point hedonic scale as mentioned by Amerin *et al.* (1965) [1].

3. Results and discussion
3.1 Effect of storage on moisture content of green tea doughnut
Samples were packed in LDPE. Though LDPE has low permeation of air and water still moisture content of doughnut packed in LDPE increases with increase in storage period because the water absorptive capacity of green tea doughnut is high so it gains moisture very easily. Moisture content of 0% green tea doughnut was highest as compared to others. Figure 1 showed that there was increase in the moisture content during storage days. This was due to the high moisture holding capacity of green tea. Moisture absorption by the product reduces its shelf life, as it gives a medium for microbial growth, acceptability of the product. The result was in conformity with Kent & Evers, 1994 [6]. Moisture content in doughnut increased with storage period.

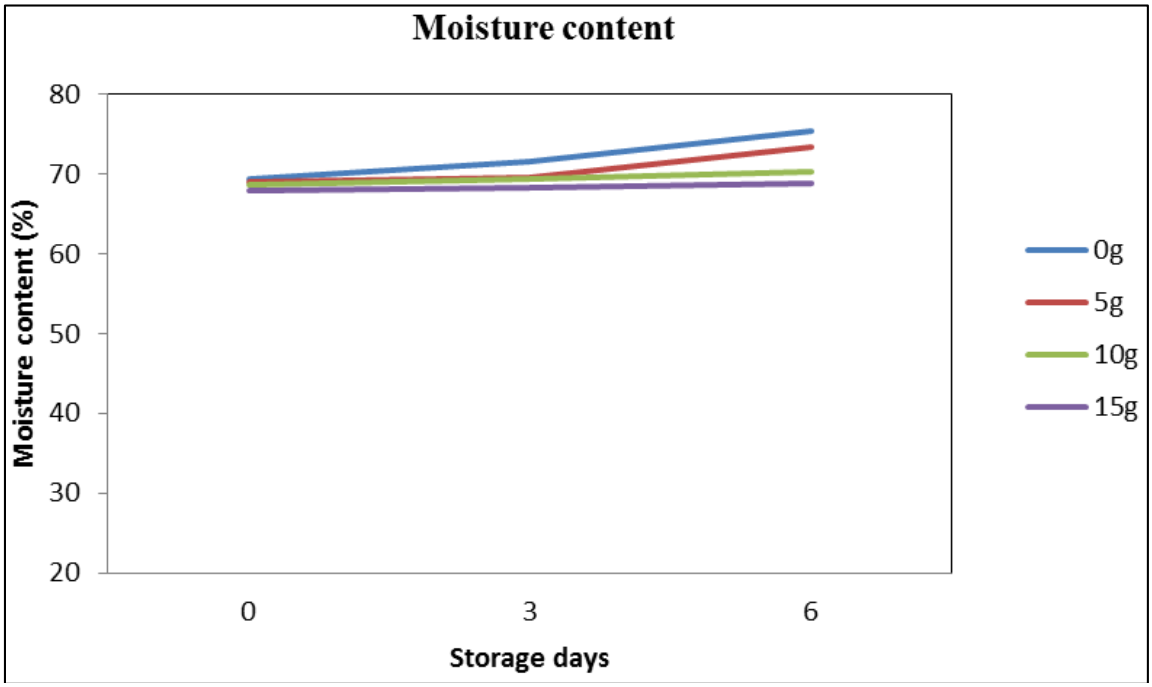

Fig 1: Effect of storage on moisture content of green tea doughnut

3.2 Effect of storage on fat content of green tea doughnut
On evaluation of results it was found that fat content of the green tea doughnut was almost constant during storage because green tea acts as a fat stabilizer. The fat content of experiments was found to be increased with the increasing substitution. Fat content was found maximum in the 15 % sample. There was very little difference in fat content in the time period of storage. Samples showed little changes in their fat content and it was decreased with the increasing storage days due to little oxidation of the fat. The reason of observing constant pattern in fat content of sample was due to use of same amount of butter in all samples and slight increase was found with increasing green tea concentration due to fat stabilizer property of green tea. Figure 2 showed the effect of different samples and storage periods on percent fat content of green tea doughnuts.

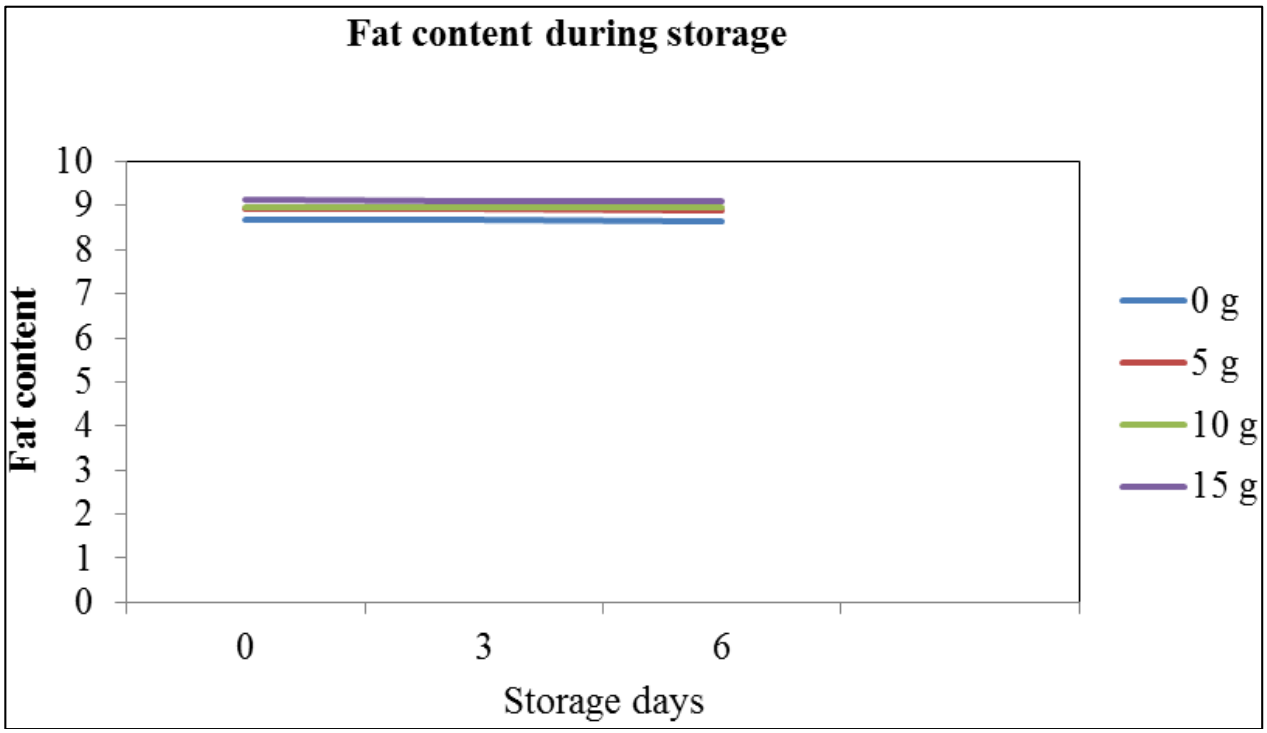

Fig 2: Effect of storage on fat content of green tea doughnut

3.3 Effect of storage on pH of green tea doughnut

pH of different green tea doughnuts was presented in Table 4.3. pH of doughnut increased with increasing percentage of green tea powder as antioxidant component of green tea was alkaline so by its addition to doughnut the pH was increased. pH of 15% substitution of green tea was high (6.3) than control (5.8). Storage changed the pH of green tea doughnuts as it decreased with the increasing days. There was very slight decrease in pH of doughnut during storage as basic nature of bioactive component of green tea changed to slight neutral form as a result decrease of pH was observed.

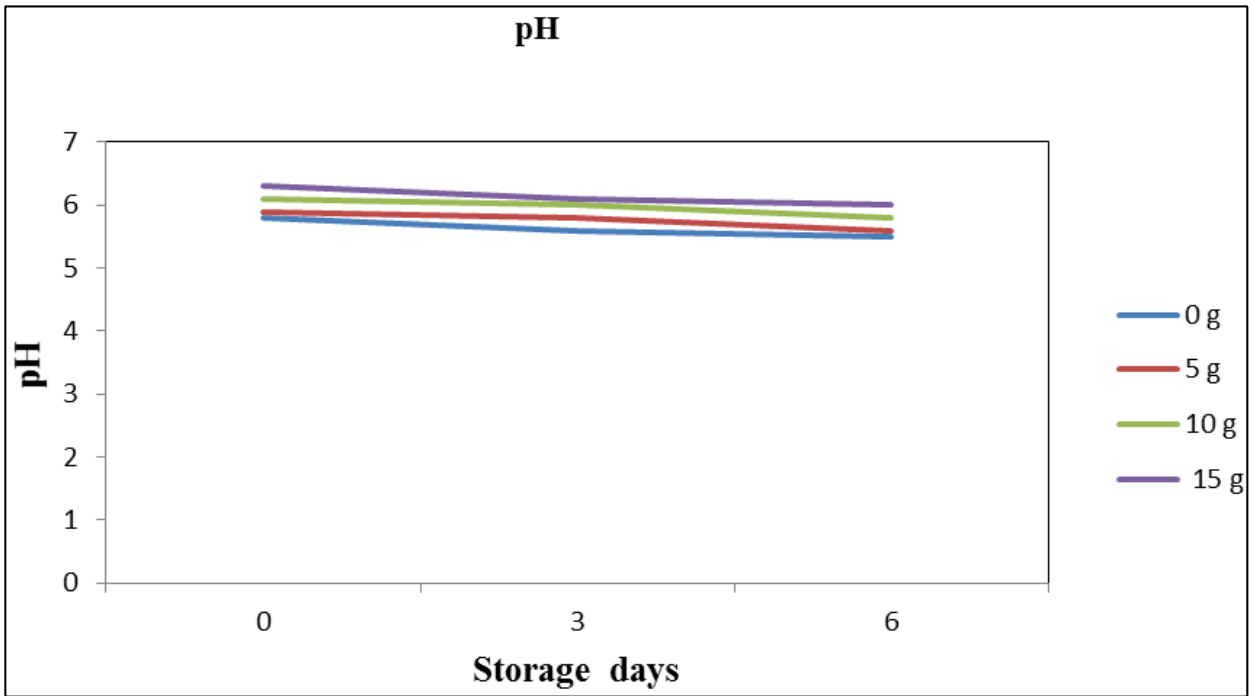

Fig 3: Effect of storage on pH of green tea doughnut

3.4 Effect of treatment on volume of green tea doughnut

The volume of the doughnut depends on the concentration of green tea, the volume decreased as the concentration increased. This was due to the green tea incorporation as more concentration of green tea incorporated the hardness increased and volume decreased (Budryan et. al., 2012) [3].

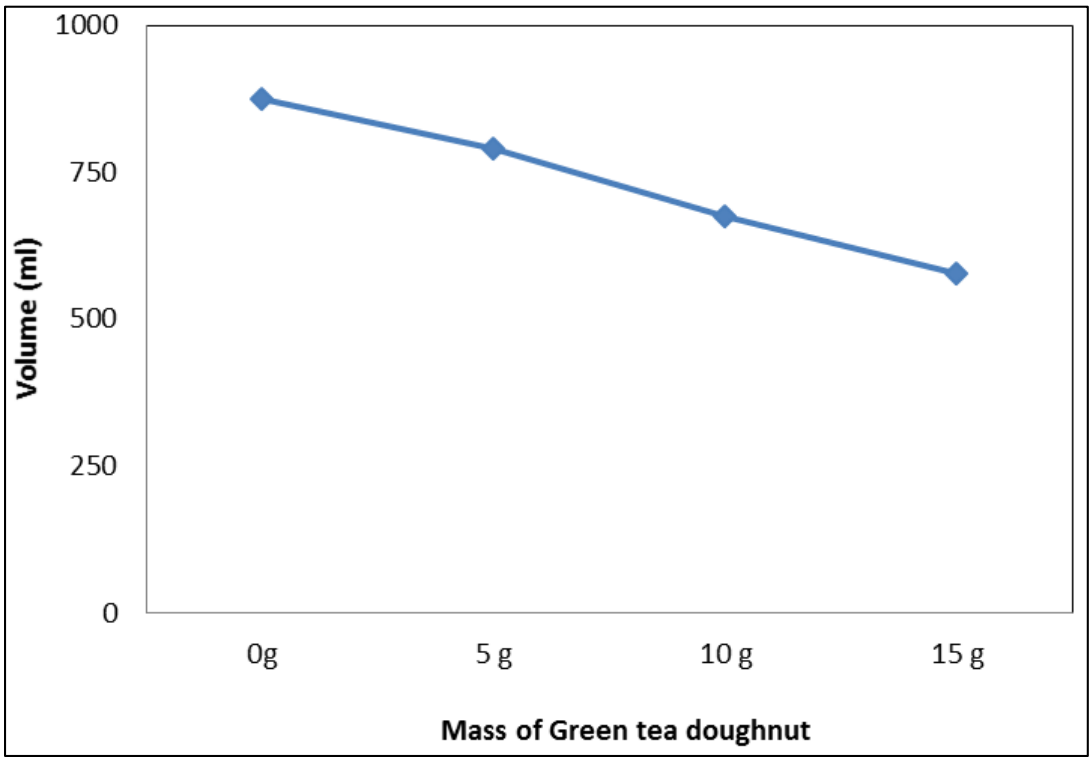

Fig 4: Effect of treatment on volume of green tea doughnut

3.5 Effect of storage on ash content of green tea doughnut

The effect of storage period and different contents of doughnut on ash content of sample packed in LDPE. The ash content of doughnut was increased with increasing green tea concentrations and little increase of it was found with increasing storage days. Figure 5 showed the effect of different samples and storage days on ash content. The increase in ash content in doughnuts with increasing green tea concentration was due to inorganic antioxidant components of green tea that led to increase ash content. The result was in conformity with (Ragone, 1997) [10] that had showed increase in ash content due to increase in antioxidant components.

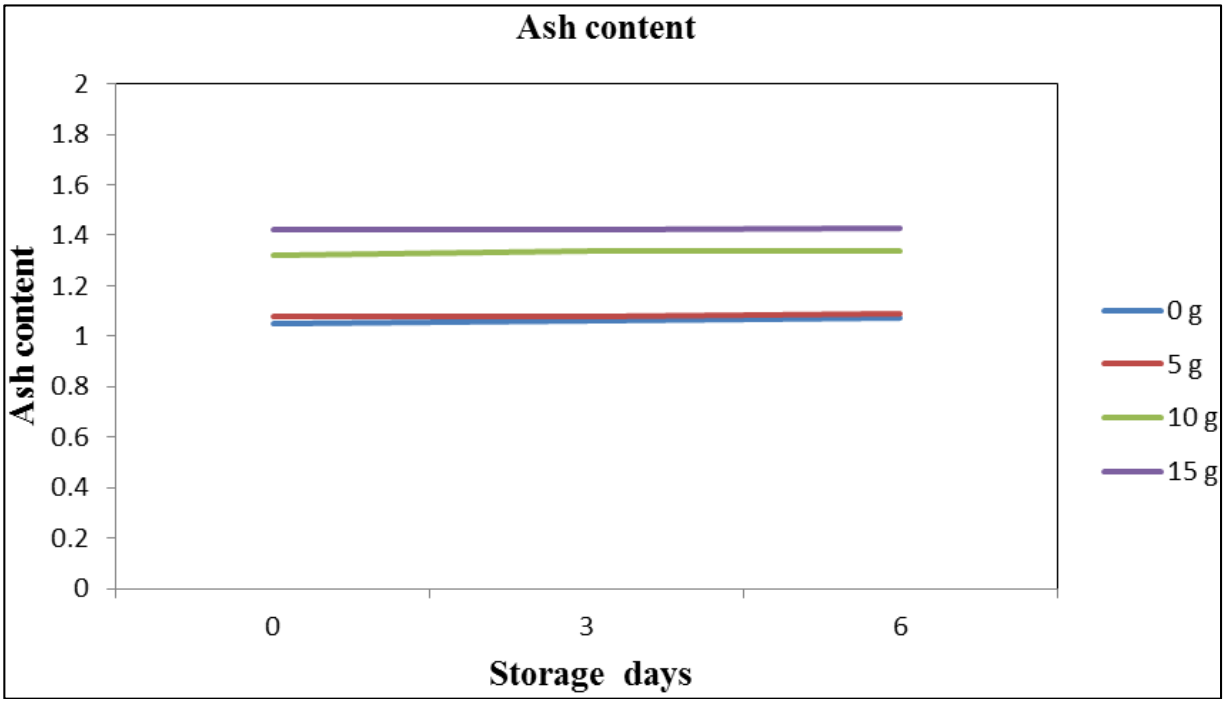

Fig 5: Effect of storage on ash content of green tea doughnut

3.6 Effect of storage on total phenolic content

TPC of green tea doughnut increased with increasing green tea concentrations. TPC was found highest in 15 % green tea substituted sample, storage had less effect on TPC of green tea doughnuts. However, the decrease in TPC during storage of each green tea doughnut was observed. This was due to change in phenolic content of green tea due to storage. Phenolic content of green tea was changed during storage due to effect of oxygen that bound to phenolic compounds and formed oxidized compound as a result decrease in TPC was observed.

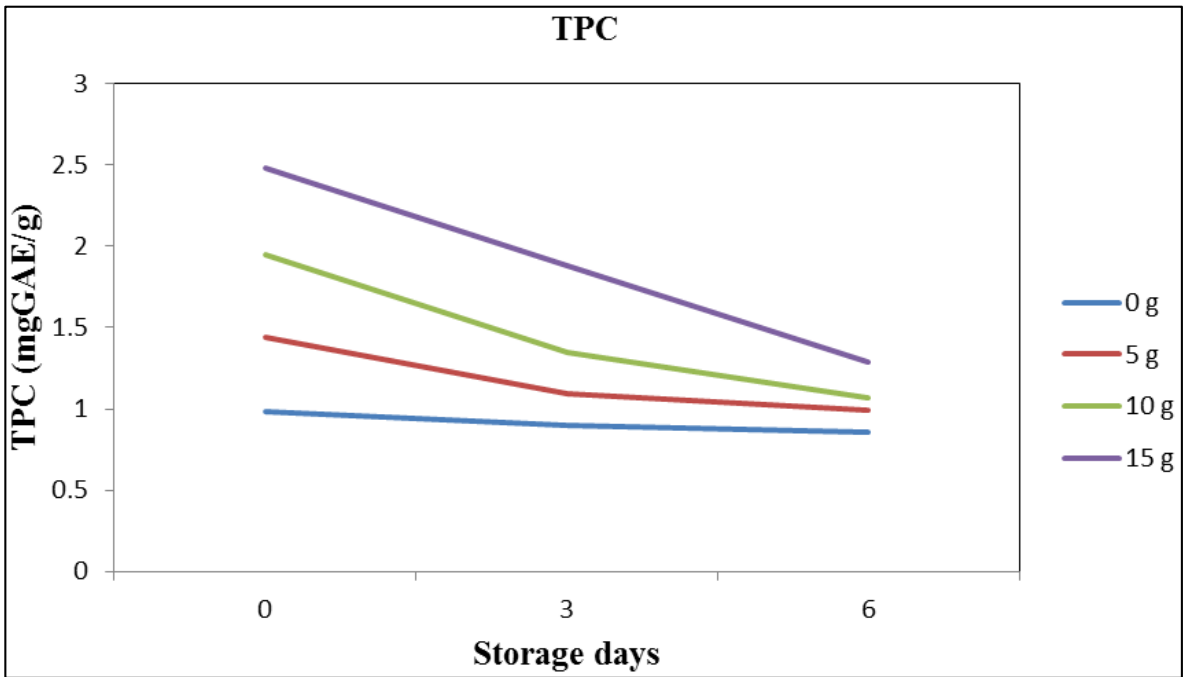

Fig 6: Effect of storage on TPC of green tea doughnut

3.7 Effect of storage on DPPH value

Antioxidant property of doughnut using ethanol as an extract showed increase in DPPH with the increase in green tea concentration of green tea doughnuts as shown in Figure 7. This increase was due to increase in bioactive components with the increasing concentration of green tea as a result DPPH value of green tea doughnut increased. Storage decreased the DPPH as radical scavenging activity of green tea doughnut reduced.

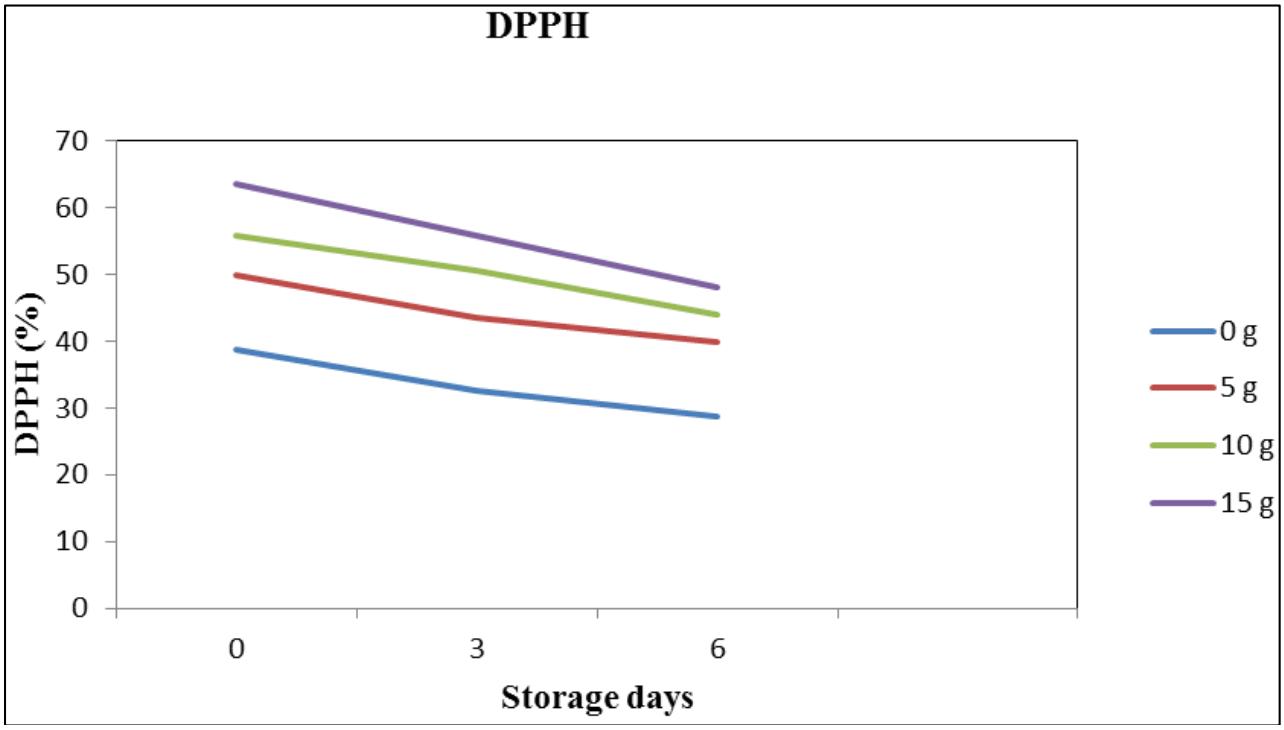

Fig 7: Effect of storage on DPPH value of green tea doughnut

3.8 Sensory Evaluation

The result indicated that tea affected the crust characteristics of doughnut. On the other hand crust color of doughnut change from brown to deep brown with increase in the replacement of wheat flour with green tea the crust was however found to have a slightly rough surface. The sample with the most desirable characteristics was found in 10% replacement of wheat flour with green tea powder. The highest score for overall acceptability was obtained for 10% green tea substituted sample due to its better taste and flavor.

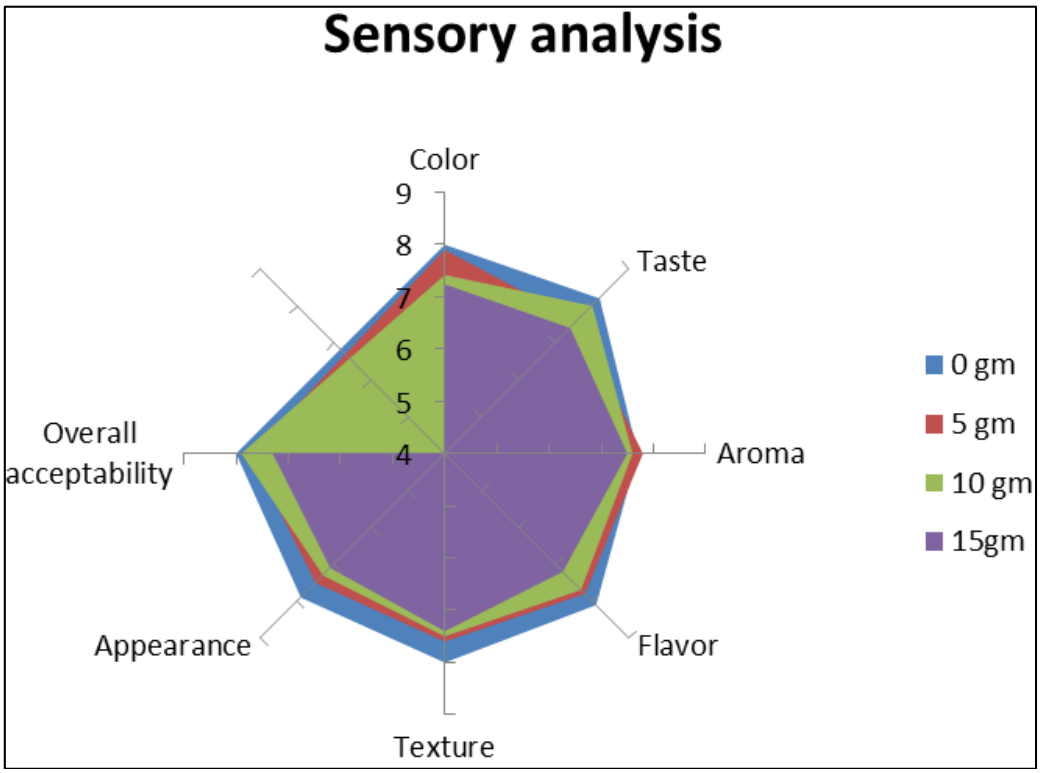

Fig 8: Sensory Evaluation

4. Conclusion

A successful and novel formulation of doughnut production with green tea was developed. Green tea is a good source of catechins and dietary fiber. Doughnut formulated with partial replacement of wheat flour with up to 10% green tea had bioactive components and a pleasant tea flavor as compared to doughnut prepared with 100% wheat flour. Green tea doughnut had good antioxidant property and it was concluded that green tea could be incorporated into doughnut and provide green tea doughnut with more functional components and more effective antioxidant properties. The bakery industry should endeavor to consider how green tea can be used for baking to increase the quality. Hence, it can be concluded that Green tea can be used to bake doughnut and produce bakery products.

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