

A study on standardization of value added products from different varieties of figs grown in Ballari District of Kalyana Karnataka

Comment [WU1]: Add the different varieties in parenthesis ()

ABSTRACT:

Background: The fig fruit, *Ficus carica* L., (Moraceae family) is one among the major fruit crops grown in Ballari district of Kalyana Karnataka. Due to rapid respiration rate and significant ethylene production fruits are climacteric and extremely perishable. Among the three varieties namely Ballari, Daenna, and Turkey brown are grown in Ballari District, Ballari variety covers larger area. Although growing fig is a year-round farming activity in the region, there are just a few fig processing technologies available to adopt. ICAR-KVK, Ballari conducted a study to develop novel value-added products using fig varieties grown in the district. Processes to make dry fruit fig burfi and fig-banana rolls were standardised and nutritional value of the standardised products were analysed. After 60 days of storage, an organoleptic evaluation and microbiological analyses were carried out. Dry fruit burfi and fig-banana rolls made from Ballari variety were shown to be more nutrient-dense and performed better in organoleptic test when compared to those made with other varieties. Microbial loads test after 60 days of storage period showed the total plate counts below the permissible IFSA (International Flight Services Association) requirements for fig burfi and fig banana rolls made of all the three varieties. None of the products had any mould or yeast.

Comment [WU2]: Remove and add conclusion to the abstract

KEYWORDS: fig rolls, burfi, shelf life, organoleptic evaluation

INTRODUCTION:

Fig (*Ficus carica*) is one of the oldest known and first cultivated fruit trees in the world. Fig belongs to the mulberry family Moraceae and is containing 800 tropical and subtropical plant species. It is also known as 'Anjir' in Asia, 'Fiege' in German, 'Figue' in French and 'Higo' in Spanish.

In India, its cultivation is mostly confined to western parts of Maharashtra (Pune) and Gujarat, Uttar Pradesh (Lucknow and Saharanpur), Karnataka (Ballari, Chitradurga and Srirangapatna) and Tamil Nadu (Coimbatore) (Naikwadi 2010). The fig, often known as the "fitness fruit," is one of the most significant medicinal fruits that can be found anywhere in the globe. Fig can be grown in more humid settings, such as the tropics and subtropics, but it

Comment [WU3]: Add more detailed literature survey

is especially well suited to Mediterranean climates with cool winters and hot, dry summers. Once established, fig is very drought tolerant, and dry, hot summers are preferable for commercial production. However, fig requires frequent irrigation to produce higher yields.

Over 5600 hectares of land are used for fig farming in India, producing 13.802 thousand tonnes annually, or 12.32 tonnes per hectare. According to the annual report of KSDA, Ballari for the year 2019-20, 1800 hectare area is under fig fruit cultivation in the district producing 14,087.83 metric tonnes and yielding 7.82 tons/ha. One of the main fruit crops grown in Kalyana Karnataka's Ballari district is the fig. A locally cultivated fig called "Ballari variety" is one among the few varieties grown across India. It has high market demand because of its superior quality, sweetness, and colour when compared to other varieties, and is available all through the year.

Figs often have a sweet flavour and a chewy texture. Figs are highly prized in both their fresh and processed forms because they are a repository of vital nutrients and phytochemicals that are rich in antioxidants. Daenna and turkey brown varieties of fig are grown in this region. Due to popular customer demand from all over Southern India, the Ballari variety is more prevalent than the other two. Although growing figs is a year-round farming activity in the region, there are just a few fig processing technologies that can be used. In order to develop fresh value-added products from locally grown fig types, the current experiment was undertaken.

MATERIAL AND METHODS:

ICAR-KVK, Ballari, conducted the study by collecting the fruits from the farmer fields in Kurugodu Taluk of Ballari district. The firm and fully grown fig fruits of three varieties—Ballari, Turkey Brown, and Daenna—were procured. In the laboratory investigations, analytical-grade chemicals were employed, while other raw materials were purchased at the neighbourhood market.

Optimization of procedure for making standardized fig products:

Process for producing two products, fig dry fruit burfi and fig-banana rolls, were standardised, enabling for process optimization. Necessary ingredients were procured from the local market. The three fig fruit varieties were washed separately, manually de-stemmed, and cleaned of debris before being prepared for processing. The production method for two value-added goods, fig dry fruit burfi and fig-banana rolls, were optimized. Using various varieties of figs cultivated in the area, the fig products were made in three variations.

The flowcharts for the preparation of fig dry fruit burfi and fig banana rolls are shown in Fig. 1 and Fig. 2, respectively.

Fig 1: Schematic diagram of the process for the production of the fig dry fruit burfi

Comment [WU4]: The figures heading should be under the figure and not above

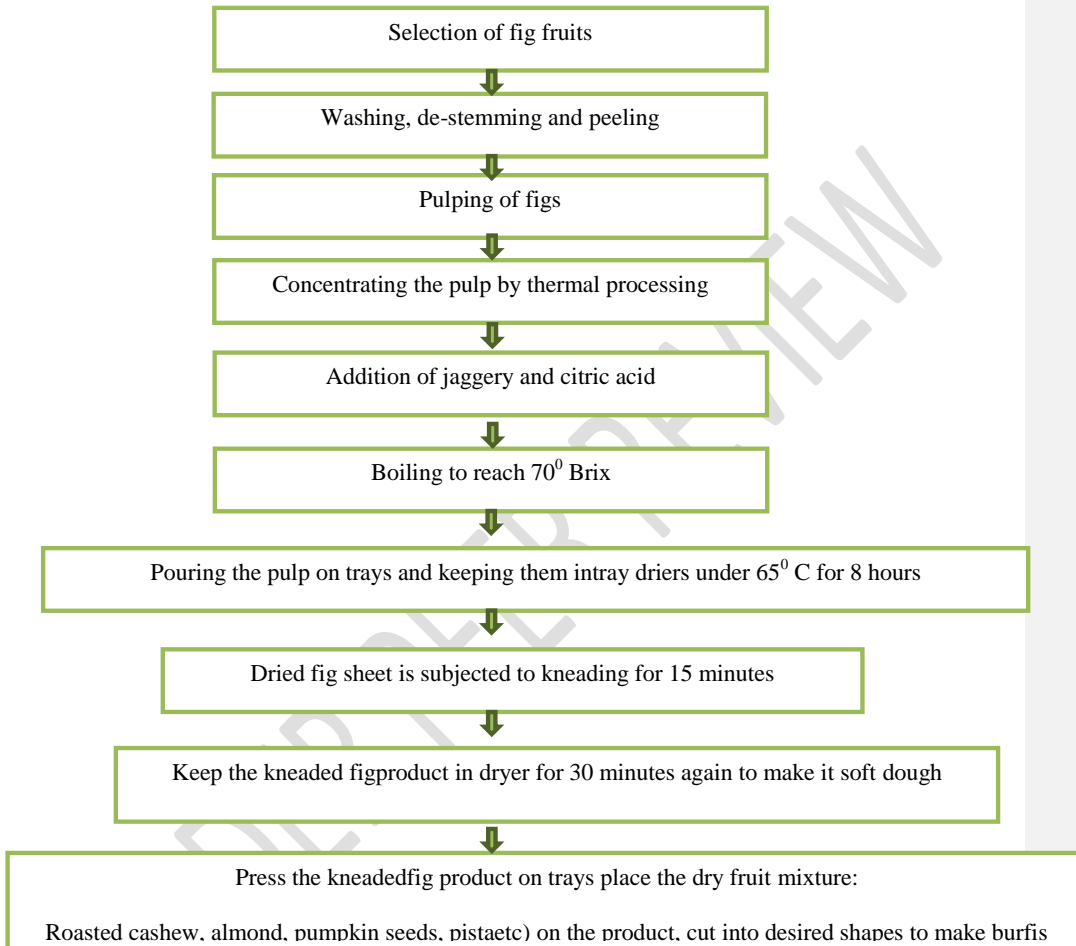
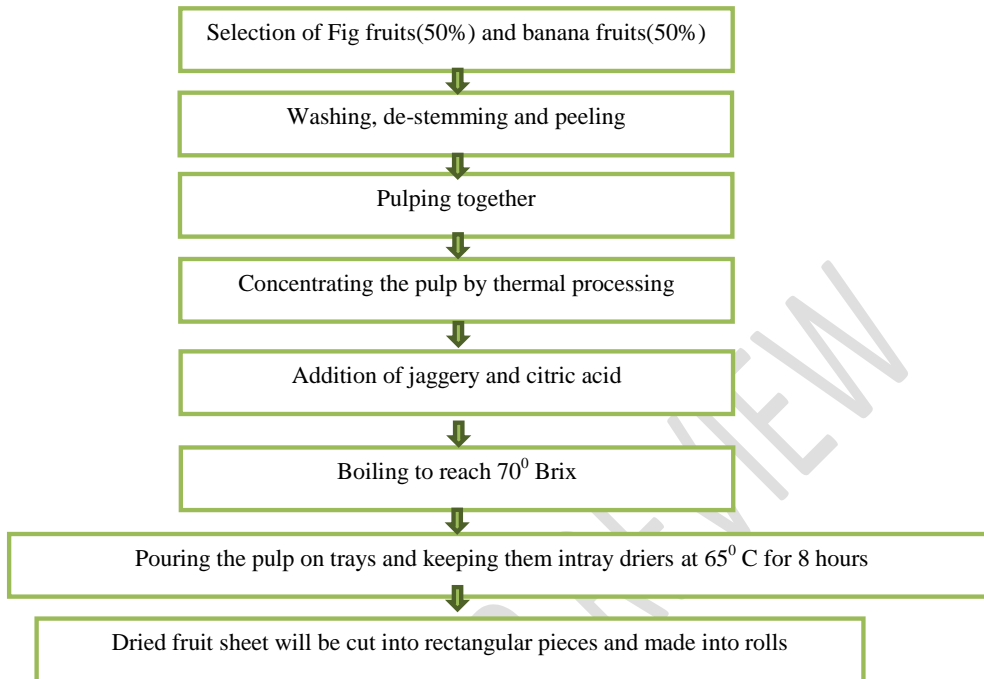


Fig 2 : Schematic diagram of the process for the production of the fig-banana rolls

Comment [WU5]: The figures heading should be under the figure and not above



UNDER PEE... NEW

Analysis of the nutritional value of fig products:

The standardised fig products were tested at the Pesticide Residue and Food Quality Analysis Laboratory, UAS, Raichur for moisture, total minerals (g), fat, fibre, protein, carbohydrates, calcium, and iron using the AOAC, 2000 methods.

Organoleptic evaluation of the standardized products:

A panel of 21 semi-trained judges conducted an organoleptic study of fig products. A 9-point Hedonic scale was used to evaluate the sensory characteristics, including appearance, taste, flavour, texture and overall acceptability (Larmond, 1997).

Studies on the shelf life of the standardised products: The standardised fig products were tested for their sensory qualities every 30 days over the course of three months. The products were also put through storage tests for 60 days at room temperature. Using established microbiological techniques, the total plate count, mould count, and yeast count were performed on the first day and on the 60th day of storage.

RESULTS AND DISCUSSION

As mentioned by Varma *et al.*, 2013 among the confectionery, burfi is one of the most popular khoa-based *sweet all* over the country. The generic nomenclature “burfi” covers a wide range of product variations that include plain, danedar, dudh, chocolate, fruit and coconut burfi. Typically, it has a mildly caramelized and pleasant flavour. Multi-layered and multi-coloured varieties are also produced. In our study, the burfi is made with fig, dry-fruits and jaggery. According to Dhumal *et al.*, (2018) fruit leathers/rolls are dehydrated fruit based products and are tasty, chewy, dried fruit products. They are prepared by pouring pureed fruit onto a flat surface for drying. When the dried fruit is pulled from the surface and rolled it gets the name of leather, from the fact that when the pureed fruit is dried, it is shiny and has texture of ‘leather’.

In the present study, we have developed the process of making fig dry fruit burfi as well as fig-banana rolls(leathers) individually. The nutritional analysis of developed fig products was carried out in triplicates and average values are presented in Table 1. The results of nutritional value of fig dry fruit burfi and fig-banana rolls made from three different varieties of fig fruits showed non-significant differences. The reason for slight differences in the results may be due to the differences in the

nutritive value of the fig fruit varieties used, whereas the nutritive value of the banana and the dry fruits used remained same. Fig dry fruit burfi made from Ballari variety showed higher protein(12.78g),calcium (17.45mg) and iron(6.0mg) content compared to other two varieties whereas Deanna variety burfi showed better fat(0.65g) and fibre content(4.99g).

Table 1. Nutritive value of fig dry fruit burfi and fig-banana rolls developed from different varieties of figs grown in the district

Nutrients	Fig dry fruit burfi			Fig-banana rolls		
	Deanna	Ballari Variety	Turkey brown	Deanna	Ballari Variety	Turkey brown
Moisture (%)	10.30	10.13	11.21	10.62	10.11	11.08
Total minerals (g)	2.09	1.98	2.06	1.93	2.06	2.10
Fat (g)	0.65	0.57	0.62	0.06	0.05	0.06
Fibre (g)	4.99	4.91	3.86	1.44	1.67	1.62
Protein (g)	3.21	12.78	3.32	0.17	0.70	0.50
Carbohydrates (g)	70.18	80.11	80.79	76.22	81.26	81.24
Energy (K cal)	299.00	373.00	354.00	306.00	328.00	331.00
Calcium(mg)	15.92	17.45	15.37	15.0	14.2	14.4
Iron(mg)	2.70	6.0	4.5	4.64	3.58	4.25

Fig banana rolls made from Ballari variety showed higher total mineral content(2.06g),fibre(1.62g),protein(0.70g) and carbohydrates (81.26 g) compared to other two varieties.The number of consumers who are aware of nutritional and functional foods is increasing. Customers want to consume safe foods that provide additional benefits alongside their nutritional value. However, customers are more inclined to buy these functional foods due to positive health benefits. Furthermore, people are becoming increasingly interested in functional foods (Bigliardi,2013).

The characteristics of functional foods are thought to be high levels of protein, fiber and the total phenolic content (Ali,2019). The nutritious qualities found in fruits and vegetables are responsible for this effect (Widlanskyet al.,2005). These are a great source of phenolic compounds, minerals, amino

acids and vitamins (Duenaset *et al.*,2008). Dried figs have ability to potentially promote health due to the presence of high levels of polyphenols(Vallejo.,2012).

Study conducted by Salem *et al* in the year 2022 revealed that the dried fruit of fig has carbohydrates as a major component (73.50%) that corresponds to its high energy value (317.78 kcal), very low amount of fat (0.56%),a moderate amount of protein (4.67%) while dietary fiber content was (3.68%).Fig contains both soluble and insoluble dietary fiber that has a number of health benefits.Thus the developed fig banana rolls and fig dry fruit burfi are excellent source of energy.Farahnaky, *et al.* (2009) found that the chemical composition of the dried fig was about 69.1 % of polysaccharides, 4.3% protein; 2.46% fat, 12.1% carbohydrate and 3.1% ash.Vinson *et al.*, (2005) quoted that both fresh and dried figs have high amounts of fiber and polyphenols. Figs are found to be a rich source of amino acids. Khapre *et al* (2015) studied the nutritional value of fig powder incorporated burfi the results showed the burfi was rich in fiber (3.7 %), potassium (0.464 %) and protein (13.12 %).

Fig 3: Mean scores of Organoleptic evaluation of fig dry fruit burfi developed from different varieties grown in Ballari district (N=21)

Comment [WU6]: The figures heading should be under the figure and not above

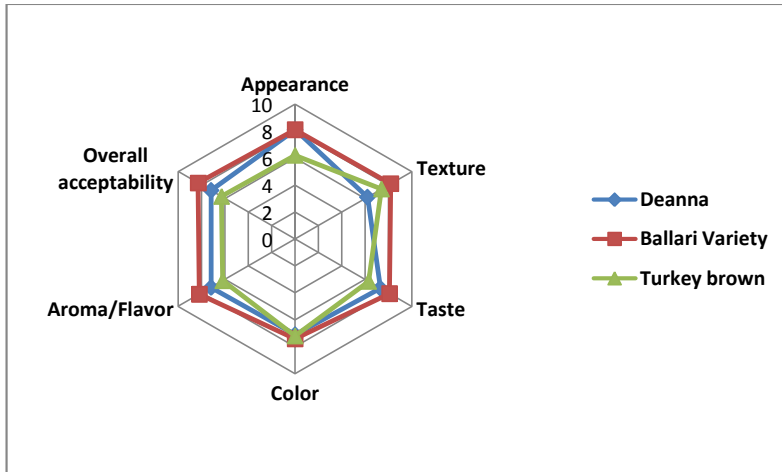
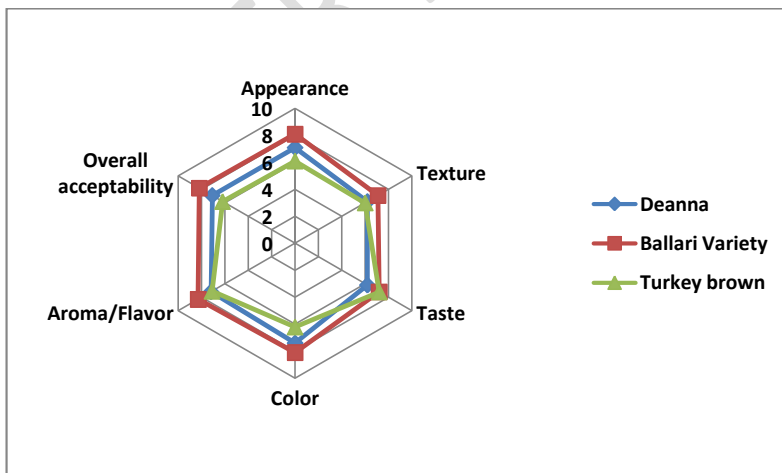


Fig 4: Mean scores of Organoleptic evaluation of fig-banana rolls developed from different varieties grown in Ballari district (N=21)

Comment [WU7]: The figures heading should be under the figure and not above



Organoleptic evaluation proved that fig dry fruit burfi (Fig 3) made from Ballari variety has scored more for all the parameters of sensory evaluation like

appearance, texture, taste, color, aroma, overall acceptability compared to burfi made from other two varieties. Fig banana rolls (Fig 4) made from Ballari variety has scored more in overall acceptability and other parameters of sensory evaluation. The reason could be higher TSS content of the fruits. A similar study conducted by Khapre *et al* 2011 also showed that organoleptically best quality fig toffee can be obtained with the formulation containing 100 g fig powder, 220 g sugar, 35 g SMP, 32 g vegetable fat and 32 g liquid glucose (Khapre *et al* 2011).

It is worth noting that the texture of fruit leathers can be evaluated in several ways. The human mouth is more complex at evaluating the texture as opposed to a penetrometer which might measure just one aspect of texture (Huang and Hsieh, 2005; Pomeranz and Meloan, 2000).

Mounika and Uma maheshwari (2019), studied the sensory evaluation of mixed fruit leathers, and the results showed that fruit lather made from mixed fruits is significantly better in taste, taste score of the Sample average 7.25 whereas for color it was 7.0.

Table 2: Microbial load of fig burfi and fig-banana roll samples after a storage period of 60 days

Products	Varieties	Name of the test	Microbial load on initial day of storage (cfuXdf)	Microbial load After 60 days of storage (cfuXdf)
Fig dry fruit burfi	Deanna	Total plate count	Nil	10.2 X 10 ²
		Mould and yeast count	Nil	Nil
	Ballari Variety	Total plate count	Nil	8.94 X 10 ²
		Mould and yeast count	Nil	Nil
	Turkey brown	Total plate count	Nil	4.63 X 10 ²
		Mould and yeast count	Nil	Nil
fig + banana rolls	Deanna	Total plate count	Nil	8.2 X 10 ²
		Mould and yeast count	Nil	Nil
	Ballari Variety	Total plate count	Nil	7.9 X 10 ²
		Mould and yeast count	Nil	Nil
	Turkey brown	Total plate count	Nil	5.63 X 10 ²
		Mould and yeast count	Nil	Nil

The microbial safety of any food product is very important aspect especially if the product is intended to be stored for long time. The results of shelf life studies showed no total microbial load on day-1 of the developed products. Whereas upon 60 days of storage fig dry fruit burfi and fig banana rolls made from all the three varieties of figs showed presence of microbial load but they were within the range of IFSA (International Flight Services Association) permissible limits of 10^6 for food samples. Singhet *et al* (2019) studied the storage stability of guava leather in two different packaging materials like biaxially oriented polypropylene and punnets. Microbial analysis showed the leathers were safe for consumption till 4 months of storage in both packaging. A study conducted by Dhumal *et al* (2018) showed that the microbial quality viz., yeast and mould count were found to be increased during 180 days of storage in fig leather but was found to be within acceptable levels.

Conclusion:

From the present study it was concluded that varieties of fig (*Ficus carica*) namely Ballari variety, Daenna, and Turkey brown grown in Ballari district of Kalyana, Karnataka are popular in Southern India. KVK, Ballari conducted a study to develop value-added products from all the varieties and evaluated for their suitability and consumer preference. Process for making fig-banana rolls and fig dry fruit burfi have been optimized. The Ballari variety produced more nutrient dense and organoleptically best fig dry fruit burfi and fig-banana rolls. All the products developed from three varieties of figs had microbial loads below the IFSA requirements.

REFERENCES:

- AOAC (2000), Official Methods of Analysis. 17th Edition, The Association of Official Analytical Chemists, Gaithersburg, MD, USA.
- Ali, A.; Rahut, D.B. (2019) Healthy foods as proxy for functional foods: Consumers' awareness, perception, and demand for natural functional foods in Pakistan. *Int. J. Food Sci.*, 6390650.
- Bigliardi, B.; Galati, F. (2013) Innovation trends in the food industry: The case of functional foods. *Trends Food Sci. Technol.* 31, 118–129.

Comment [WU8]: Please update your reference 80% in (2020-2023) from Journal indexed by Scopus

- Dhumal C.Y. , Dhemre J.K. , Shete M.B. and Ambad S.N.(2018)., Storage study of fig (*ficus carica L.*) leather. International Journal of Agriculture Sciences. Volume 10, Issue 6, 2018, pp.-5488-5493.
- Duenas, M.; Perez-Alonso, J.J.; Santos-Buelga, C.; Escribano-Bailon, T. (2008), Anthocyanin composition in fig (*Ficus carica L.*). J. Food Compos. Anal, 21, 107–115.
- Farahnaky, A., Ansari S and Majzoobi, M. (2009): Effect of glycerol on the moisture sorption isotherms of figs. Journal of Food Engineering, 93: 468-473.
- Huang X and Hsieh FH. (2005) Physical properties, sensory attributes, and consumer preference of pear fruit leather. Journal of Food Science. 70(3):177-186.
- Khapre A P., Satwadhar P N and Syed H. M. (2015). Studies on processing technology and cost estimation of fig (*Ficus carica L.*) fruit powder enriched Burfi (Indian cookie) Journal of Applied and Natural Science 7 (2) : 621 – 624.
- Khapre A P., Satwadhar P.N. and Deshpande H.W (2011)., Development of technology for preparation of fig (*ficus carica L.*) fruit powder and its utilization in toffee. J. Dairying, Foods & H.S., 30 (4) : 267 - 270, 2011.
- Larmond L (1997) Laboratory Methods for Sensory Evaluation of Foods,” Canada Department of Agriculture Publication, Ottawa.
- Naikwadi P M., Chavan U. D. . Pawar V. D. and Amarowicz R (2010), Studies on dehydration of figs using different sugar syrup treatments. J Food Sci Technol (July–August 2010) 47(4):442–445.
- Pomeranz Y and Meloan CE. (2000) Food Analysis. Theory and Practice, 3rd Edition, Aspan Publishers, Gaithersbury Maryland,; 416.
- Salem, T. G., Ameen, A. A., and Haggag, M. H. (2022). The effect of dried figs (*Ficus carica L.*) on hypercholesterolemia in rats. International Journal of Health Sciences, 6(S9), 637–655.
- Singh L J., Tiwari R.B and Ranjitha K (2019). Storage Stability of Guava Leather in Two Type of Packaging Int.J.Curr.Microbiol.App.Sci (2019) 8(7): 2465-2472.
- Varma, T., Singh, J., Ram Niwas, Singh, D., Gautam, A.K. and Kumar, S. (2013). Impact of feeding soy enriched burfi on the internal body parts of the albino rats. International Journal of Agricultural Sciences, 3(6): 550-552.

Vallejo, F.; Marín, J.G. and Tomas-Barberan, F.A. (2012) Phenolic compound content of fresh and dried figs (*Ficus carica L.*). *Food Chem.*, 130, 485–492.

Vinson, J.A., Zubik, L., Bose, P. Samman, N. and Proch J.(2005): Dried fruits: excellent in vitro and in vivo antioxidants. *Journal of the American College of Nutrition*; 24(1):44–50.

Widlansky, M.E.,Duffy, S.J., Hamburg, N., Gokce, N.,Warden, B.A., Wiseman, S.,Keaney, J., Frei, B. and Vita, J.A. (2005) Effects of black tea consumption on plasma catechins and markers of oxidative stress and inflammation in patients with coronary artery disease. *Free. Radic. Biol. Med.*, 38, 499–506.

UNDER PEER REVIEW