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UTILIZATION OF MANGO PEELS AS A SOURCE OF PHYTOCHEMICALS IN BISCUITS

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ABSTRACT

Phytochemicals, a term used for chemical compounds that occur naturally in plants and have biological significance. It is well-known that plants produce these chemicals to protect themselves but recent research demonstrate that they can also protect humans against diseases and also play a role in preservation of foods. Mango (*Mangifera indica* L.) is rich in phytochemicals. During processing of mango especially in industries, peel forms a major by-product and contributes about 15 – 20 per cent of the fruit. Mango peel is a rich source of natural bioactive compounds which are health beneficial. In the present study, the effect of mango peel powder (MPP) at different replacing levels (5, 10, 15 and 20%) on sensory and antioxidant properties of biscuits were evaluated. The results revealed that MPP had high contents of protein, ash and crude fibre. The content of phenolics was 6.66 mg / g, flavonoid content was 2.19 mg per g of biscuit incorporated with MPP. The biscuits incorporated with MPP exhibited an improvement in their antioxidant properties. The DPPH radical scavenging activity of the biscuits was observed to be 82.36 per cent while for control it was 28.28 per cent. Acceptable biscuits with mango flavour were obtained by incorporating up to 20% MPP but the most acceptable was the one with 15 per cent addition. Organoleptically significant difference was found for overall acceptability between control and treatments. Thus, the results indicated that by incorporating mango peel powder, it is possible to enhance the nutritional quality and improve the antioxidant properties of biscuits.

INTRODUCTION

The tenet "Let food be thy medicine and medicine be thy food," espoused by Hippocrates nearly 2,500 years ago, is receiving renewed interest. In particular, there has been an explosion of consumer interest in the health enhancing role of specific foods or physiologically-active food components, so-called functional foods. Clearly, all foods are functional, as they provide taste, aroma, or nutritive value. Within the last decade, however, the term functional as it applies to food has adopted a different connotation that of providing an additional physiological benefit beyond that of meeting basic nutritional needs. The term functional food refers to processed foods containing ingredients that aid specific bodily functions in addition to being nutritious. Phytochemicals, a term used for chemical compounds that occur naturally in plants and have biological significance. It is well-known that plants produce these chemicals to protect themselves but recent research demonstrate that they can also protect humans against diseases and also play a role in preservation of foods. There are more than thousand known phytochemicals. Some of the well-known phytochemicals are phenols in fruits and vegetables, lycopene in tomatoes, isoflavones in soy and flavanoids in fruits. Mango (*Mangifera indica* L.) belonging to the family *Anacardiaceae*, is one of the most cultivated fruit in the world, and is also rich in phytochemicals. Mango peels are a rich source of phytochemicals mainly phenols and flavonoid and beta carotene. During processing of mango, peel is a major by-product. As peel is not currently utilized for any commercial purpose, it is discarded as a waste. Ajila, *et. al.,* (2007) reported that mango peel contains a number of valuable compounds such as polyphenols, carotenoids, enzymes and dietary ûbre. U.S. Patent application US 2002/0187239 A1 have proposed the use of mango by products as a source of nutritional constituents (Miljkovic and Bignami, 2002 D. Miljkovic and G.S. Bignami, Nutraceuticals and methods of obtaining nutraceuticals from tropical crops. USA. Application number: 10/992.502 (2002)

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Published In. Google Patent.Miljkovic and Bignami, 2002). As mango is a seasonal fruit, about 20 per cent of fruits are processed for products such as puree, nectar, leather, pickles and canned slices, among others, which have worldwide popularity. Huge amount of bio waste is produced by the food industries. In mango bio-waste processing, drying may be an essential step to inactivate enzymes responsible for degrading many active compounds and to decrease the rate of microbial growth. Kalpna, *et. al.,* (2011) also reported that mango peel showed best antioxidant capacity may be because of its higher phenolic content which normally is the major determinant of antioxidant potential of food plants. Therefore, mango peel may become important as a cheap and noticeable natural source of compounds with health protective potential, which can be used in pharmaceutical, nutraceutical and food preparation. Kim *et. al.,* (2010) noted that the mango peels exhibited good antioxidant activity by effectively scavenging various free radicals, such as DPPH radicals, hydroxyl radicals and alkyl radicals.

Biscuits are the most popularly consumed bakery items in the world. Some of the reasons for such wide popularity are their ready to eat nature, affordable cost, good nutritional quality, availability in different tastes and longer shelf life. Bakery products are popular both in urban and rural India. The aim of the present work was to study the effect of mango peel powder (MPP) at different replacing levels (5, 10, 15 and 20%) on sensory and antioxidant properties of biscuits were evaluated.

RESEARCH METHODOLOGY

The ripe mangoes (*desi* variety) purchased from the local market was washed thoroughly with water and then peeled off the fruit. The peels were removed using a sharp knife and the underlying pulp removed by gently scraping with its blunt edge; peeling was done in a linear fashion of about 2- 3 inches size, so that uniform drying occurs. The peels were then subjected to thorough washing and then dried (Figure 1). The dried mango peels were then grounded and sieved through a sieve to obtain a powder with a particle size of 841 microns.

Biscuit Processing

Biscuits samples were processed from doughs containing 5, 10, 15 and 20% of mango peel powder according to the method given in Figure 1. After baking, biscuits were left to cool at room temperature and were wrapped tightly with polyethylene laminate pouches and kept until further analysis.

Sensory analysis

The prepared recipes would be evaluated for their organoleptic characteristics, appearance, colour, flavour, texture, taste and overall acceptability by a panel of ten judges on nine point hedonic rating scale.

Nutrient analysis

Mango peel powder and organoleptically selected cookies prepared were analysed for proximate composition (moisture, protein, fat, fibre and ash) using standardized techniques (NIN, 2003). The carbohydrate content of sample will be calculated by difference method. Energy content of the sample will be determined by using fuel value of protein, fat and carbohydrate.

Bioactive compound determination

Mango peel powder was analysed for antioxidant activity *via* total phenol which was determined according to Folin-Ciocalteu's reagent method (Mc Donald *et. al*., 2001). Total flavonoid content was determined according to aluminium chloride colorimetric method (Chang *et. al*., 2002). And the free radical scavenging activity will be measured by using 2, 2- diphenyl-1-picryl-hydrazyl (DPPH) by the modified method of McCune and Johns (2002).

Statistical analysis:

All data were expressed as mean values ± SD. Statistical analysis was performed using one way analysis of variance (ANOVA) with $p < 0.05$ being considered statistically significant. All the analysis was carried out in triplicate.

RESULTS AND DISCUSSION

According to Karva and Bharti (2008) sensory attributes are the major criteria after cooking for the acceptability of the products. However nutritious a product is, unless accepted it does not serve the purpose. Quality is the main criterion on which the acceptability of any product depends (Anon, 1995). Quality is the degree of excellence and is a composite character determining the acceptability of a product (Srilakshmi, 2007). **F**ood quality detectable by

our senses can be broken down into the main categories *viz.* appearance, colour, flavour, texture and taste. Hence, the developed products were evaluated by a panel of ten judges on nine point hedonic rating scale. Among the four treatments and the control proposed, for each of the five ready to eat food products, the most acceptable two treatments (including control) with maximum organoleptic qualities were selected.

Sensory evaluation

The appearance of diamond cookies prepared by adding mango peel in different ratios scored a maximum of 8.74 for control, and a minimum of 6.97 for TM-$_4$ (Table 1) The scores obtained for colour ranged from 7.80 to 8.80. Flavour obtained a high score of 8.64 to 8.84. Maximum score of taste and texture was obtained by control of 8.84 each and minimum was obtained by TM$_4$ of 7.47, 7.97 respec-

Table 1: Mean acceptability scores and index of mango peel added diamond cookies

Treatments	Quality attributes					
	Appearance	Colour	Flavour	Taste	Texture	Overall acceptability
Control	8.74^x	8.80^x	8.84^x	8.84^x	8.84^x	8.81^x
	(21.85)	(22.00)	(22.10)	(44.20)	(22.10)	(132.25)
TM$_1$ (5%)	8.00^y	8.27^x	8.80^x	8.54^y	8.44^y	8.32^y
	(20.00)	(20.68)	(22.00)	(42.70)	(21.10)	(126.48)
TM$_2$ (10%)	8.04^y	8.24^x	8.77^x	8.40^z	8.34^z	8.28^y
	(20.10)	(20.60)	(21.93)	(42.00)	(20.85)	(125.48)
TM$_3$ (15%)	8.83^x	8.47^x	8.84^x	8.77^w	8.67^w	8.72^x
	(22.08)	(21.18)	(22.10)	(43.85)	(21.68)	(130.88)
TM$_4$ (20%)	6.97^z	7.80^y	8.64^x	7.47^v	7.97^v	7.97^z
	(17.43)	(19.50)	(21.60)	(37.35)	(19.93)	(115.80)

Figures in parenthesis are the calculated index values
Values with the different super script in the column differ significantly at 5 per cent level of significance

Table 2. Nutrient and bioactive constituents of dried mango peel and diamond cookies g per 100 g

Nutrient and bioactive constituents	Mango peel	Diamond cookies	
		Control	Mango peel added (15 %)
Moisture	2.90 ± 0.96	0.36 ± 0.01	0.33 ± 0.07
Protein	4.87 ± 0.34	5.75 ± 0.17	6.72 ± 0.01
Fat	0.41 ± 0.27	20.80 ± 0.17	20.96 ± 1.57
Fibre	9.56 ± 1.15	0.82 ± 0.08	3.77 ± 0.13
Ash	3.37 ± 0.28	1.49 ± 0.02	1.25 ± 0.20
Carbohydrate	78.93 ± 1.98	70.82 ± 0.29	66.99 ± 1.78
Energy (Kcal)	338.76 ± 9.16	493.36 ± 0.74	483.44 ± 6.99
Phenol content (catechol equivalents mg/g)	117.62 ±0.18	1.83 ± 0.07	6.66 ± 0.13
Flavonoid content (quercetin equivalents mg / g)	11.73 ±0.78	0.62 ± 0.18	2.19 ± 0.17
DPPH Antioxidant activity %	88.33 ±0.61	28.28 ± 2.85	82.36 ± 1.32

Values are expressed on dry weight basis

tively. The scores for over all acceptability of mango peel incorporated diamond cookies ranged between 7.97 and 8.81. On the basis of appearance there was no significant difference between TM_1, TM_2 and TM_3 while significant difference was observed between control and treatments and between TM_4 and TM_1, TM_2 and TM_3. For colour significant difference was found only between control and TM_4, while for flavour no significant difference was noted. Significant difference was found on the basis of taste, texture and over all acceptability between control and treatments. After, calculating the index it was observed that TM_3 obtained a total value of 130.88 which was next to the total value obtained by control (132.25). Although all the treatments were well accepted the most acceptable treatment was TM_3. It was noticed that incorporation of 20 per cent mango peel powder in diamond cookies (TM_4) caused relatively dark colour, the increase in the darkness was reflected in the products which may be due to enzymatic browning. The findings were in accordance with Ashoush and Gadallah (2011) who also reported enzymatic browning to be the reason for rejection of biscuits prepared by adding 20 per cent of mango peel powder.

Nutrient analysis

The moisture content of mango peel of *desi* variety (fresh) was found to be 70.91 ± 0.57 g $100g^{-1}$ which was reduced to 2.90 ± 0.96 g $100g^{-1}$ on drying, while the moisture content of diamond cookies (TM_3) was 0.33± 0.01 per cent (Table 2). The moisture content is in accordance with the findings of Ajila *et. al.,* (2010). The proximate content of diamond cookies was higher than that of the control due to the addition of mango peel powder at 15 per cent level. The carbohydrate content of the mango peel added diamond cookies was found to be lower than the control which due to the fact that energy content was found by difference so when the other contents increased the carbohydrate content decreased. The energy content also decreased as it was obtained by the calorific value of protein, fat and carbohydrate. The phenolic content of mango peel powder was found to be 117.62 ± 0.18 while the phenolic content of diamond cookies was found to be 6.66 ± 0.13 catechol equivalents mg per g. The findings of phenol content are in conformity with the reporting of Ashoush and Gadallah (2011), Ajila *et. al.,* (2010) and Ajila *et. al.,* (2008).

Even though there was some loss during processing there was increase in the phenolic, flavonoid and DPPH antioxidant activity of the diamond cookies prepared by adding mango peel powder which was a resultant of the addition of the same at 15 per cent level. The DPPH antioxidant activity increased to 82.36 per cent from 28.28 per cent in control which is in line with Ashoush and Gadallah (2011).

CONCLUSION

Based on the above results, it could be concluded that the mango peels and seed kernels powders could be used as a potential source for functional food ingredients and, in addition, it could be further processed into therapeutic functional food products or as antioxidants in preservation of foods.

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