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Studies on preparation of antioxidant enriched *burfi*

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Abstract
Antioxidants can be synthetic or natural. However, exploitation of natural antioxidants especially from plant sources has greatly increased in recent years. It has been reported that these wastes and by-products of fruits are an abundant source of natural antioxidants. Pomegranate and orange peels are good natural antioxidants due to the presence of polyphenolic compounds which are known to be potent antioxidants. The aim of the present investigation was to study the yield, total phenolic content and total antioxidative activity of pomegranate and orange peel extracts and their effect on the sensory characteristics of burfi. The antioxidants from pomegranate peels (POP) and Orange peels (OP) were extracted by using ethanol and ethyl acetate. The results obtained were the yield of ethyl acetate extract showed highest yield of 24.64% for orange peels and ethanol extract showed highest yield of 26.5% for pomegranate peel. Among the two extracts POP exhibited a high percentage of total phenolic content and total antioxidant activity of 185.43mg/g and 98.56% respectively than the OP which showed 110.77mg/g and 75.48%. Burfi was prepared to give four variations i.e., (T0) 0 (control), (T1)0.05, (T2)0.1, (T3)0.15 and (T4)0.2% of both the extracts per cent by weight of burfi and then subjected to sensory evaluation for colour and appearance, body and texture, flavour, sweetness and overall acceptability. As the fruit peel extract level increased, sensory scores decreased as compared to control.

Keywords: *burfi*, pomegranate peels, orange peels

Introduction
Burfi is one of the most popular *khoa* based indigenous sweets. The quantity of *Burfi* produced in India exceeds any other milk based sweet using *khoa* as raw material (Patel *et al*., 1985) [18]. It is white to light cream in color with firm body and smooth texture with very fine grains. Sugar is added in different proportions and other ingredients are incorporated according to the demand of consumers. There are different *burfi* varieties viz. plain, nuts, fruits, chocolate, coconut and rava *burfi*. Production and marketing of *Burfi* in general is mostly confined to the 'Halwai' (traditional sweets-makers) and only few commercial manufacturing units exist in market. However, these products suffer low keeping quality. One of the reasons for this is its unpredictable shelf life (Suresh & Jha, 1994) [23]. The shelf life of unpacked product is about 5-7 days at room temperature (Vijayalakshmi *et al*., 2005) [24]. From the chemical deterioration point of view, fat-oxidation gives rise to undesirable changes such as objectionable odour and flavour, rancidity and bleaching of fatty food colours, consequently prolong the shelf-life of the food (Giese, 1996) [10] So, various preservatives and anti-oxidant needs to be incorporated to the product to control such defects thereby increasing shelf-life of the product. Antioxidants can be synthetic or natural. Exploitation of natural antioxidants especially from plant sources has greatly increased in recent years. The development on application from natural resources is favored by a number of factors notably: (a) Safety, since they are part of food man has been eating for thousand years. (b) Effectiveness, since they survive processing operations. (c) Their use is not guided by regulatory rules. (d) Their source is renewable.

Special attention has been paid to wastes generated in the food industry, such as peel, wastewaters and seeds. Numerous scientific investigations point at consecutive rich sources of antioxidants, especially among fruits, but only few of them involve waste parts of fruits, i.e. seeds and peels. It has been reported that these wastes and by-products of fruits are an abundant source of natural antioxidants (Balasundaram *et al*., 2006). When these are used by food processors gives high economic benefits (Jang *et al.*, 2012) [13]. The peels of some fruits have higher antioxidant activity than pulps (Fuhrman *et al*., 2005) [8]. Pomegranate is a good example for this type of fruits wherein their peels constitute approximately 50% of the total fruit weight of Pomegranate corresponds to the peel, which is more important source of bioactive compounds such as phenolics, flavonoids, ellagitannins, and proanthocyanidin compounds (1.261%). The phenolic constituents, ellagic tannins and ellagic acid are among the potent antioxidants in peels (Seeram *et al.*, 2005) [15]. Intelligent utilization of pomegranate

peel has been successfully experienced in various food preparations including meat and meat products, edible oils, bakery products and jellies (Altunkaya *et al*., 2013) [2]. Pomegranate peel acts as excellent natural additives for food preservation and quality enhancement. Its use in food and nutraceutical industry is also on the rise (Ismail *et al.*, 2012) [12]. Orange is the major citrus fruit produced worldwide and processed commercially for orange juice. Several researchers reported that orange peel is a good natural source of phyto-constituents which exhibit antioxidant activities than edible portions of the fruits (Bombardelli and Morazzoni, 1993) [7]. The aim of the present investigation was to extract antioxidants from orange and pomegranate fruit peels by using ethanol and ethyl acetate and to study the yield, total phenolic content and total antioxidative activity of pomegranate and orange peel extracts and their effect on the sensory characteristics of burfi.

Materials and Methods

Raw Materials: Buffalo milk, Pomegranate and orange fruits of good quality were purchased from local fruit market, Raipur (C.G), India.

Methods

Preparation of pomegranate & orange peel powder: Pomegranate and Orange fruits were sorted manually to remove the damaged fruits then the fruits were washed twice under running tap water followed by distilled water to remove dust, dirt and other foreign matter. The washed fruits were peeled by using stainless steel knife to obtain peels which were sized 1.75× 2.0 cm. Then the peel pieces were dried to remove moisture in hot air oven @ 40^0c for 8 hrs. The dried peel pieces were ground into fine powder by electrical grinder and stored separately in air tight amber colour bottles to avoid light effects and stored in deep fridge at -20 ^{0}C.

Extraction of antioxidant from pomegranate and orange peels: The antioxidants were extracted by cold percolation method using ethanol and ethyl acetate as solvents separately. 10 g of the peel powder was soaked in 100 ml of ethanol/ ethyl acetate in conical flask, plugged with cotton wool and then kept in orbital shaker at 120 rpm for 24 h. After 24 h the extract was filtered through Whatman filter paper No.41 for removal of peel particles and concentrated under vaccum at 40 ºC. The dry extract was stored at 4 ºC (Singh, 2014) [22]. Solvents and techniques generally regarded as "environmental friendly" were applied. Extraction is the crucial first step because it is necessary to extract the desired chemical components from the plant materials for further separation and characterization (Seabra, 2010) [21].

Determination of extract yield: The extraction yield is a measure of the solvent's efficiency to extract specific components from the original material and it was defined as the amount of extract recovered in mass compared with the initial amount of whole plant. It is presented in percentage (%). The dry extract obtained after filtration was weighed for the extraction yield (Singh and Immannuel, 2014) [22].

Extraction yield (%) = (weight of the residue) / (Total weight of the peel powder) × 100

Preparation of *Burfi* enriched with fruit peel extracts: *Burfi* was prepared as per the methodology given by Ranganadham *et al*., (2016) [19]. Burfi was prepared to give 4 variation of POP and OP extracts being (0.05%, 0.1%, 0.15%, 0.2 %,) and BHA being (0.02%).

Sensory evaluation of prepared product: Sensory evaluation of antioxidant enriched *burfi* carried out by a panel of judges using "9 point Hedonic scale" from the Faculty members of different Departments of College of Dairy Science and Food Technology, Raipur.

Results and Discussion

The study was conducted to prepare antioxidant enriched *burfi.* So firstly the antioxidants were extracted followed by determination of total phenolic content, antioxidant properties of obtained POP and OP extracts. From the results obtained the ethanol extract showed highest yield in case of POP that was 27.5% and the ethyl acetate showed highest yield of 23.9 % in case of OP. The study revealed that ethanol is the best solvent for the extraction of antioxidants from pomegranate peels whereas ethyl acetate is best in case of orange peels for maximum yield of antioxidants. The yield of different extracts under this study has been observed and the results obtained were more or less in accordance with the values reported as follows. Singh, (2014) [22] reported that maximum yield of antioxidants using ethanol as a solvent was extracted with pomegranate peel and showed the yield of 27.5%. Gehan *et al.*, (2014) [9] reported pomegranate peels showed maximum yield of antioxidants by using 80% ethanol as a solvent than ethyl acetate and n-hexane. Maria *et al.*, (2004) reported that orange peels showed high phenolic content and radical scavenging activities were found for the ethyl acetate fraction. For extraction of condensed tannins, flavonoids, and other phenolics ethanol is the best solvent (Rowell *et al*., 2005) [20]. From the above stated results it can be observed that extraction of antioxidants from POP and OP were depending on the various factors that affect the extraction yield significantly like extraction temperature, extraction time, and type of fruits used and concentration of solvent used. All these factors individually and interactively affect the extraction yield of phytochemical polyphenol compounds.

Table 1: Yield of POP, OP peels

Solvents	OP (%)	POP (%)
Ethanol	23.62	26.5
Ethyl acetate	24.64	22.40

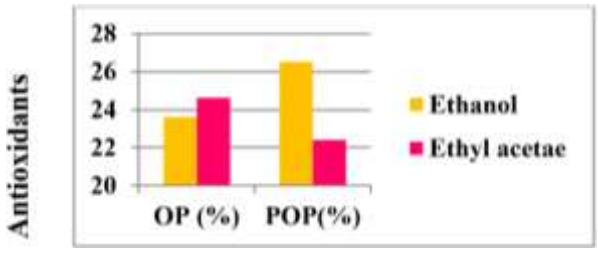

Fig 1: Yield of POP, OP peels

Total phenolic content (TPC) and total antioxidant activity in fruit peel extracts

From the Table 2. and Figure 2 the results revealed that the TPC of POP extract was (185.43 mg/g) and orange extract was (110.77 mg/g) respectively. The results revealed that the TPC of POP extract was (185.43 mg/g) and orange extract was (110.77 mg/g) respectively. Singh, (2014) [22] reported

that TPC was found maximum in pomegranate peel (249.41 mg/g) and in orange peels 169.56 mg/g. (Gehan *et al*., 2014) [9] also reported that pomegranate peels showed total phenolic content of 124.67 for pomegranate peels by using 80% ethanol. Maria *et al*., (2004) reported that orange peels showed high phenolic content and also revealed that ethyl acetate seems to be the solvent, concentrates best phenolic substances. The variations observed in TPC may be due to using different varieties of fruit peels, different extraction conditions and use of even different solvents. The results of total antioxidant activity of pomegranate peel was 88.56 and for orange peel extract is 75.48%. From the above stated results the antioxidant activity obtained is in accordance with Maria *et al*., (2004) as he reported that orange peels showed high radical scavenging activities. Singh, (2014) [22] also reported that the maximum antioxidant activity of 92.7% was found in pomegranate peels and also reported that the antioxidant activity of orange peels was found to be 71.4%. The variations observed in the results of antioxidant activity may be due to using different verities of fruit peels, different extraction conditions like time temperatures used and use of even different solvents.

Table 2: Total phenolic content and total antioxidant activity of fruit peels

Peels	TPC (mg/g)	Antioxidants (%)
OP	110.77	75.48
POP	185.43	88.56

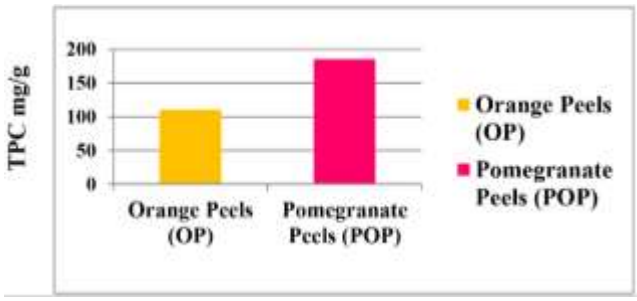

Fig 2: Total phenolic content and total antioxidant activity of fruit peels

Sensory evaluation of fruit peel enriched *burfi:* Sensory evaluation of fruit peel extract enriched *burfi* was done to know the effect of fruit peel extracts on sensory characteristics of freshly prepared *burfi* and the results were shown below.

Table 3: Effect of POP extracts addition on the sensory characteristics of fresh *burfi:*

Treatments	Color & Appearance	Sweetness	Flavor	Body & texture	Overall acceptability
T0	8.10±0.29	8.19±0.27	8.32±0.24	8.27±0.24	8.22±0.09
T1	8.10±0.31	8.15±0.42	8.16±0.23	8.26±0.32	8.16±0.06
T2	8.20±0.43	8.15±0.22	8.13±0.44	8.26±0.27	8.19±0.06
T3	7.96±0.48	7.95±0.44	7.76±0.20	8.25±0.16	7.98±0.20
T4	7.50±0.47	7.55±0.34	7.51±0.37	8.22±0.16	7.69 ±0.35
C.D.	0.44	0.47	0.37	N/S	0.29

($p<0.05$), N/S – not significant, Where T0- Control, T1- 0.05%, T2- 0.1%, T3-0.15% and T4-0.2% POP extract added *burfi*

From table 3 there was a significant difference in the sensory scores of all characters of POP extract added *burfi* except in body and texture. The level of POP extract incorporation was restricted to a maximum of 0.1%. As compared to control, the lower flavor score in POP samples above 0.1% might be due to the bitterness caused by the pomegranate peels, which must have reduced the flavor score as the level of incorporation of POP extract increased. The difference in the colour and appearance score was due to slight brown colour caused by the addition of POP extract. The colour and appearance score decreased with the level of extract incorporation increased above 0.1%. As the addition of POP extract was in very little concentration it did not show any significant effect on body and texture of *burfi.* The overall acceptability score of T2 having 0.1% was highest among all other POP extract added *burfi* samples but decreased after this level.

Table 4: Effect of OP extracts addition on the sensory characteristics of fresh *burfi*

Treatments	Colour & Appearance	Sweetness	Flavor	Body & Texture	Overall acceptability
T0	8.10±0.35	8.19±0.30	8.32±0.24	8.27±0.25	8.22±0.09
T1	8.15±0.36	8.15±0.27	8.32±0.17	8.24±0.27	8.21±0.08
T2	8.14±0.27	8.14±0.28	8.33±0.14	8.24±0.15	8.21±0.09
T3	8.21±0.27	8.15±0.27	8.39±0.14	8.25±0.18	8.25±0.10
T4	7.92±0.37	8.02±0.37	7.81±0.24	8.22±0.16	7.99±0.17
C.D.	0.06	0.11	0.025	N/S	0.11

($p<0.05$), N/S – not significant, C.D.-Critical Difference, Where T0- Control, T1- 0.05%, T2- 0.1%, T3-0.15% and T4-0.2% POP extract added *burfi.*

From table 4 there was a significant difference in the sensory scores of all characters of OP extract added *burfi* except in body and texture. The level of OP extract incorporation was restricted to a maximum of 0.15 %. As compared to control, the higher flavor score in OP samples was be due to the pleasing aroma of orange peels, which might have increased the flavor score as the level of incorporation of OP extract increased. The slightly higher score of colour and appearance of T3 was be due to the presence of OP extract which had slight orange colour which was very appealing. In the same way compared to control, the lower flavor score in OP samples above 0.1% might be due to the bitterness caused by the orange peels, which must have reduced the flavor score as the level of incorporation of OP extract increased. The difference in the colour and appearance score was due to more intensity in colour caused by the addition of OP extract. As the addition of OP extract was in very little concentration it did not show any significant effect on body and texture of *burfi.* The overall acceptability score of T2 having 0.1% was highest among all other POP extract added *burfi* samples but

decreased after this level. From the sensory evaluation the samples having highest score which are T2 for POP (0.1%) and T3 for OP (0.15%).

Conclusion

Pomegranate and orange peels are good natural antioxidants due to the presence of polyphenolic compounds which are known to be potent antioxidants. The results obtained were the yield of ethyl acetate extract showed highest yield of 24.64% for orange peels and ethanol extract showed highest yield of 26.5% for pomegranate peel. Among the two extracts POP exhibited a high percentage of total phenolic content and total antioxidant activity of 185.43mg/g and 98.56% respectively than the OP which showed 110.77mg/g and 75.48%. Burfi was prepared to give four variations i.e., (T0) 0 (control), (T1)0.05, (T2)0.1, (T3)0.15 and (T4)0.2%. Sensory evaluation was done and (T2)0.1% was best selected sample in case of POP and (T3)0.15% in case of OP. So intelligent utilization of these peels can be done in any fat containing foods as natural preservatives and as natural source of antioxidants.

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