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Standardisation of juice extraction method from phalsa (*Grewia subinaequalis* L.) fruits

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Abstract

Phalsa fruits are highly perishable in nature resulting in very high amount of postharvest losses. This could be managed only through proper value addition of the ripe fruits. Fruits are often processed into juice due to their pleasant taste and cooling effects. Phalsa juice is very popular due to its pleasing flavour and deep crimson-red colour. However, the process of extraction of juice from the phalsa fruits is highly tedious and complex process due to their minute size and bigger seed size. The recovery of juice from the fruits varies with the method of extractions such as mechanical or manual *etc.* Hence, an attempt was made to standardize the juice extraction methods for achieving greater quantity and quality of phalsa extracts. The methods used include manual crushing, microwave heat application (900 watt) prior to and after crushing, direct heat application (60°C), prior to and after crushing, and freezing followed by thawing. Among various physical extraction methods used for juice extraction from ripe phalsa fruits, the freezing and thawing method was found to be best suitable method in terms of obtaining higher percentage of recovery as well as for recording more sensory score in terms of flavour, taste and overall acceptability.

Key words: Extraction methods, *Grewia subinaequalis*, juice, phalsa, sensory quality

Introduction

Phalsa (*Grewia subinaequalis* L.) is an underexploited minor fruit of Indian origin. The genus *Grewia* belongs to the Tiliaceae family consists of around 150 species of which 40 are available in India. Phalsa plants are small, bushy and highly climate resilient as they could tolerate extreme high temperatures of 45° during summers and freezing temperatures for few days (Khurdiya and Anand, 1981a, b). These plants are often cultivated in marginal lands and peri-urban areas to facilitate timely marketing of the fruits. In India, phalsa is majorly grown in the states of Uttar Pradesh, Rajasthan, Madhya Pradesh, Punjab, Haryana, Maharashtra, Bihar, West Bengal, Gujarat and Andhra Pradesh. The fruits are highly perishable in nature owing to perishability they cannot be exported but their processed products are highly appreciable. Ripe fruits are consumed fresh in desserts, or processed into refreshing soft drinks like squash, RTS, Sherbet *etc.* which are enjoyed during hot summer months in India (Tiwari *et al.,* 2014).

Ripe fruits of phalsa contain high amounts of vitamin A, C, minerals (calcium, phosphorous and iron) and fibre; however, low in calories and fats. Fruit pulp and seeds contain essential amino acids like threonine and methionine, respectively. Phosphoserine, serine and taurine are the dominant amino acids present in fruit juice. The attractive crimson red to dark purple colour of phalsa fruit is due to anthocyanin pigments mainly, delphinidin-3-glucoside, cyanidin-3-glucoside and pelargonidin-3, 5-diglucoside. The major phytochemical compounds present in the fruit of phalsa are triterpenoids, fatty component, flavonoids (quercetin, quercetin-3-O-β-D-glucoside and naringenin-7-O-β-D-glucoside), steroids, saponins and tannins. The fruit possess very high antioxidant activity due to presence of vitamin C, phenolics, flavonoids, tannins and anthocyanins. In the fruit, highest antioxidant activities are found in fruit peel followed by pulp and seeds.The air-dried phalsa seeds are also rich in linoleic acid, besides containing fair amount of palmitoleic, heptadecanoic, linolenic and arachidic acids (Khurdiya, 2001).

Phalsa is a summer season fruit and are generally harvested during the month of March-April in the South and May-June in the North India. The fruits are highly perishable thus due care must be taken while harvesting to avoid physical injuries such as bruising, skin punctures and cuts. Immediately after harvesting, prompt cooling of fruit is essential for the shelf life of phalsa. Being highly perishable in nature, the fruit cannot be stored for a longer period and must be marketed within 24 hours or used for processing to make stable products. Fruits harvested at unripe mature stage, can be stored up to 48 hours while, fully ripe fruit cannot be stored more than 24 hours at ambient conditions. Fruits harvested at turning stage can be stored for a week at 7°C under cold storage.

Post harvest losses in phalsa are very high and it can be managed by value addition in fruits. Phalsa juice is very popular due to its pleasing flavour and deep crimson-red colour. In addition, due to extremely refreshing quality of phalsa juice, it can be processed into ready-to-serve (RTS) and carbonated beverages. Syrup and squash can also be prepared with phalsa fruit juice after mixing with sugar and preserved

with sodium benzoate. However, extraction of juice from the harvested fruits is a tedious task as the seed portion is relatively more compared to the pulp/ juice content. Thus, it's a great challenge to extract juice from the phalsa fruits with all its bio-active and other health beneficial components. Hence, an experiment was designed to standardise various physical methods for extracting juice from the phalsa fruits.

Materials and Methods

Fully ripe phalsa fruits are freshly harvested from the research farm of CIAH during the early hours of the day and transported to the post harvest laboratory. In the laboratory, the fruits are sorted out to remove any unripe and damaged fruits. Later the fruits are washed under running water to remove surface dirt and other foreign materials. The fruits are then weighed and separated for imposing various treatments *viz.* T_1 (Control-Mashing/ Manual crushing); T_2 (Mashing followed by Microwaving @ 900 W for 5 min); T_3 (Microwaving @ 900 W for 5 min followed by mashing); T_4 (Heating at 60°C for 5 min followed by mashing); T_5 (Mashing followed by heating at 60°C) and T_6 (Freezing at -20°C followed by thawing). After application of various treatments, the final extraction mixture was passed through double layered muslin cloth for final filtration and squeezing. The amount of juice extracted with each treatment was measured using measuring cylinder replication wise and the pomace left over was weighed separately.

The juice extracted by various methods is subjected to sensory evaluation using 9 point hedonic scale. The sensory data for color/ appearance, taste, flavour, mouth feel and overall acceptance was recorded by using semi-trained panellists of different age groups (20-30; 31-50 and 51-60 years).The significance of various treatments analyzed using analysis of variance (ANOVA) and Fisher's Least Significant Difference at 5% level (p=0.05). The data are represented as mean values ± standard deviation; the alphabet after mean value indicates the significance at 5% level. The entire analysis was performed using online SAS program (version 9.3).

Results and Discussion

Due to high perishability of the phalsa fruits, the surplus production needs to be processed immediately for conversion into stable products such as squash/ powder from. For processing into various products, juice extraction from the ripe fruits is the basic step and the juice yield recovery varies with the method adopted for extraction. We attempted various physical treatments like application of heat, cold and microwaves (900 watt) for extraction of the juice from the ripe phalsa fruits. The effect of various physical treatments on the juice yield recovery and its sensory quality was studied.

The results of the study (Table 1) indicated that, the juice recovery was significantly high (70.56 %) from the fruits subjected to freezing at -20°C followed by thawing (T_6). This is succeeded by physical treatment of microwaving at 900 watt for 5 min prior to manual crushing (67.49 %)/ maceration (T_3) which is on par with the control treatment (T_1) where juice is extracted by traditional mashing procedure. Higher recovery from the frozen fruits could be due to formation of ice crystals within the cellar fluids resulting in the cell rupturing and release of all fluids from the cell structure during extraction after thawing. Similar reports of using freezing and thawing as pre-treatments for apple pulp prior to main processing by Nadulski *et al.* (2016). The reduction of recovery percentage in other extractions might be due to evaporation of water during heating process. Least per cent of juice recovery (51.44 %) was observed with the treatment of heating-up of macerated pulp to 60°C for 5 min (T_5) followed successively by heating of fruits @ 60°C followed by mashing (T_4) treatment (55.47 %).

Among various methods, the leftover pomace percentage was significantly low (20.49 %) in the treatment T_6 (Freezing and Thawing) while it was highest (33.29 %) in the treatment T_5 (Mashing followed by heating at 60°C). Sensory evaluation data has revealed that the scoring for colour/ appearance was more for the juice extracted through microwaving methods (T_2 and T_3). This is clearly evident from the intensity of anthocyanin pigmentation in the extracted juice (Fig. 1). This might be due to rupturing of cells and cellular components like vacuoles where the pigments such as anthocyanins are stored in the cell. Several authors reported on the advantages of microwave-assisted extraction compared to conventional extraction, such as reduced process time, lower solvent and energy demand, and higher yield (Hemwimon *et al.*, 2007; Proestos and Komaitis, 2008; Chen *et al.*, 2008). Also, the water molecule being polar in nature absorbs the applied microwave radiation efficiently. The sensory parameters taste, aroma/ flavour and overall acceptability was

Table 1 . Juice recovery obtained through various extraction methods

Treatment	Method of extraction	Juice recovery (%)	Pomace waste (%)
T1	Mash ing (Manual crushing)	$67.53^{b} \pm 0.86$	$25.40^{c} \pm 1.05$
T2	Mashing + Microwaving (5 min)	$61.65^{c} \pm 1.08$	$24.76^{c} \pm 1.43$
T3	Microwaving (5 min) + Manual crushing	$67.49^{b} \pm 1.21$	$24.57^{c} \pm 1.13$
T4	Heating (60°C) for 5 min + Mashing	$55.47^{d} \pm 1.16$	$30.72^{b} \pm 0.79$
T5	Mashing + H eating (60°C) for 5 min	$51.44^{e} \pm 0.93$	$33.29^{a} \pm 1.12$
T6	Freezing (-20°C) + Thawing	$70.56^{a} \pm 0.69$	$20.49^{d} \pm 0.85$
	LSD @ 5 %	1.79	1.93

Values are mean ± standard deviation of three replicates

Values with same letters are not significantly different at 5% level

observed to be high with the juice extracted by freezing and thawing treatment (Fig. 2) which might be due to preservation of the flavour volatiles by frozen fruits and alternatively the heat applied in other treatments could have liberated the flavour volatiles from the juice resulting in their reduced overall acceptability.

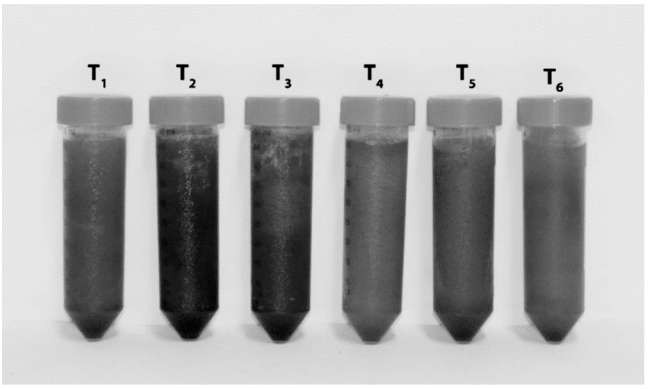

Fig. 1. Variation in the colour and pigmentation of the phalsa extract obtained by different methods

Conclusion

Among various physical extraction methods used for juice extraction from ripe phalsa fruits, the freezing and thawing method was found to be best suitable method in terms of obtaining higher percentage of recovery as well as for recording more sensory score in terms of flavour, taste and overall acceptability.

Fig. 2. Sensory acceptability of the phalsa juice extracted by different methods

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