Development of spiced squash (appetizer) from wild prickly pear (Opuntia dillenii Haw.) and its quality evaluation during storage

Monika Chauhan*
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan-173230 (Himachal Pradesh), India
N.S. Thakur
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan-173230 (Himachal Pradesh), India
Abhimanyu Thakur
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan-173230 (Himachal Pradesh), India

*Corresponding author. E-mail: monikachauhan779@gmail.com

Abstract
Wild prickly pear (Opuntia dillenii Haw.) is one of the wild fruit with great importance because of its high antioxidants, colour pigments and other quality parameters besides its medicinal properties. In India, there are only a limited number of reports pertaining to utilization of this fruit which further lack the development of value added novel products. So, the present studies were carried out for the development of spiced squash or appetizer from wild prickly pear fruit and its quality evaluation during storage. Different combinations of fruit juice (25, 30, 35 and 40 %) and sugar syrup (40 and 45 °B) were tried to standardize a proper combination for appetizer. The appetizer prepared by using the best recipe with 35 % juice, 45 °B TSS (Total soluble solids) and 1.20 % acidity was packed in two packaging materials viz. glass and PET (Polyethylene terephthalate) bottles which were further stored for six months under ambient and refrigerated temperature conditions. Appetizer packed in glass as well as in PET packaging material can be stored successfully for a period of six months under both the temperature conditions. However, various quality parameters of appetizer were retained higher in glass bottles stored under refrigerated storage conditions.

Keywords: Appetizer, Opuntia dillenii Haw., Spiced squash, Storage, Wild prickly pear

INTRODUCTION
The cactus (Opuntia spp.) - a xerophytic plant has about 130 genera and 1500 species, and belongs to family cactaceae and grows mainly in arid and semi-arid climate. The centre of origin is in Mexico, from where it got distributed throughout American hemisphere, Mediterranean basin, Middle East, South Africa, Australia and India (Zorgui et al., 2008). The two species of cactus viz. Opuntia dillenii Haw. and O. chlorotica Engelm. are known as prickly pear which are found in abundance upto 1500 metres above mean sea level. The O. dillenii Haw. is known popularly for its fruits which are edible and sweet, containing sufficient quantity of sugars, with a pleasant blend of acidity (Parmar and Kaushal, 1982; Thakur et al., 2012). This fruit consists of various antioxidant compounds like ascorbic acid, phenolics, beta-lains, flavonoids, lactones, terpenoids and alkaloids which are well known for their health-related properties. Cactus fruit being rich source of antioxidant compounds helps in treating many disease- es like diabetes, hypertension, hypercholesterolemic, rheumatic pain, gastric mucosa diseases and asthma (Osuna-Martinez et al., 2014). The juice of wild prickly pear fruits has high fibre content and it helps to reduce blood sugars and plasma cholesterol levels (Fernandez et al., 1992). So, keeping in view its availability in the barren land and importance with respect to its quality characteristics, the present studies were carried out for the development of appetizer from wild prickly pear, O. dillenii and its quality evaluation during storage.

MATERIALS AND METHODS
Raw materials and extraction of juice: The mature fruits of O. dillenii Haw. procured from Vaknaghat area of Solan district of HP were brought to the Department of Food Science and Technology, UHF, Nauni, Solan (HP), where they were used for various physico-chemical analysis, juice extraction and preparation of appetizer. The juice from the fruit was extracted with help of physical
Test (8.13) taste score was awarded to the recipe T1. The highest (7.35) body score was obtained in T5. The maximum (7.40) score for aroma was recorded in T5 and minimum (7.20) was recorded in T1 which was statistically at par with T2, T3 and T6. The highest score (8.01) of overall acceptability was obtained in T7 and lowest (6.81) in T1. Data given in Table 2 shows a significant effect of juice-acid-syrup blend on sensory scores of different recipes of wild prickly pear appetizer. The higher colour and aroma scores for recipes T5 might be due highest juice content as compared to other recipes, while recipe T7 obtained highest taste and body score which might be due to best combination of juice-syrup and sugar-acid-spices-juice blend in this recipe. The higher overall acceptability scores for recipe T7 might be due to better combination of juice-acid-spices-syrup blend coupled with attractive colour and body of the product.

**Storage of wild prickly pear appetizer**

**Physico-chemical characteristics:** There was a significant decrease in red and yellow TCU (Tintometer colour units) of wild prickly pear appetizer during storage (Fig. 1a and 1b) which might be due to degradation of betalains (betacyanins and betaxanthins) pigment. The higher degradation of betalains occurred at ambient storage conditions as compared to refrigerated conditions due to the light and high temperature. The higher retention of red and yellow colour units of appetizer packed in glass bottle was due to the slower rate of various degradation reactions and slower conduction of heat to the product as compared to the PET bottle. Suryawanshi et al. (2008), Thakur et al. (2016) and Thakur et al. (2018a) have reported a similar trend of decrease in TCU (red and yellow) during storage of pomegranate juice, box myrtle appetizer and wild prickly pear squash.

Apparent viscosity of wild prickly pear appetizer increased (Fig. 1c) significantly during the storage. The increase in strain and shearing rate along with the decrease in the flow index of the product led to develop pseudo plasticity which ultimately increased the apparent viscosity of the product (Bal et al., 2014). The other possible reason could be the formation of precipitates in appetizer which was caused due to the interaction of sugars with phenols and proteins. The increase in apparent viscosity of appetizer was observed higher in under ambient temperature conditions as compared to refrigerated conditions. Similar results of increase in apparent viscosity have been reported by El-Mansy et al. (2005) in mango and papaya nectar and Hamid and Thakur (2017) in mulberry appetizer during storage.

There was a slight increase in TSS content of appetizer during the storage period (Fig. 1d) which might be due to hydrolysis of various polysaccharides into simple monosaccharides and soluble disaccharides (Gould, 1983). The higher increase in TSS was found in appetizer stored under ambient conditions as compared to refrigerated which...
might be due to the faster reaction rates because of the high temperature in ambient conditions. The reducing sugars content of appetizer (Fig. 1e) increased significantly during storage, which was comparatively less in refrigerated storage conditions than in ambient conditions. The possible reason for this increase in reducing sugars content might be due to hydrolysis of starch into sugars.
The increase in reducing sugars was recorded higher under ambient conditions which might be due to the faster rate of reactions due to the prevalence of high temperature in ambient conditions. Similar trend of increase in TSS and reducing sugars content has been reported by Sharma et al. (2002), Selvamuthukumaran and Khanum (2013) and Thakur et al. (2018b) in plum appetizer, spiced seabuckthorn squash and wild aonla appetizer, respectively.

The titratable acidity of appetizer decreased slightly during storage (Fig. 1f) and this decrease could be attributed to the chemical interactions of organic acids of appetizer with sugars and amino acids. There was a continuous decrease in ascorbic acid content of appetizer with advancement of storage period (Fig. 1g), which might be due to its degradation into dehydro-ascorbic acid or furfural. As the ascorbic acid is highly sensitive to heat, therefore its degradation was reported higher in ambient conditions than refrigerated conditions. The results for above parameters during storage of appetizer are in accordance with the findings of Sharma et al., (2002) in plum appetizer, Deka et al., (2004) in lime-aonla appetizer, Selvamuthukumaran and Khanum (2013) in seabuckthorn appetizer and Thakur et al., (2016) in box myrtle appetizer.

A significant decrease in betalains (betacyanins and betaxanthins) content of appetizer was recorded during the storage (Fig. 1h and 1i) higher retention was observed under low temperature storage conditions. The loss of betalains in appetizer might be due to their high susceptibility to photo oxidative degradation and poor stability during storage. The possible changes that betalains may undergo during storage might be due to the breakdown of the aldimine bond, dehydrogenation, deglycosylation and isomerisation which lead to decrease in the betalains content during storage (Khan, 2016). Similar observations have been reported by Kathiravan et al. (2014) in beet root juice, Kathiravan et al. (2015) in beet root-passion blended juice.

A gradual decrease in total phenols content of appetizer was observed during storage (Fig. 1j) and the total phenols were retained higher under low temperature storage conditions. This decrease in total phenols content during storage might be due to the complexing of phenolic compounds with proteins which led to the subsequent precipitation and formation of polymeric compounds (Abers and Wrolstad, 1979). Similar observations for decrease in total phenols have also been reported by Selvamuthukumaran and Khanum (2013) in seabuckthorn appetizer and Thakur and Thakur (2017) in box myrtle squash during storage. The antioxidant activity of appetizer decreased significantly (Fig. 1k) during storage which might be due to the degradation of betalains.

Fig. 1 (g-k). Effect of storage on physico-chemical characteristics of wild prickly pear appetizer.
and ascorbic acid during storage period as reported by Mgaya-Kilima et al. (2015) in roselle-mango blended juice. Nearly, similar observations were recorded by Elez-Martinez et al. (2006) in thermal-treated orange juice and Kathiravan et al. (2015) in beetroot-passion blended juice.

**Sensory characteristics:** The colour, body, taste, aroma and overall acceptability scores of appetizer decreased significantly during storage (Fig. 2 and 3). The various browning reactions and copolymerization of organic acids of the product led to decrease in colour scores which might have led the judges to award the lower scores of colour during storage. The formation of precipitates in the product as a result of interactions between phenols and proteins decreased the body scores of the product during storage. There was a continuous decrease in taste scores of wild prickly pear appetizer during storage and the loss of sugar-acid-salt blend might be responsible for this decrease in the taste of the product. The taste scores were retained higher in appetizer stored under low temperature conditions which might be due to slow reaction rates which contributes towards the change in original sugar-acid-salt blend. The loss of various volatile aromatic compounds during storage might have led the judges to award the lower aroma scores to the product with respective storage intervals. The appetizer packed in glass bottle retained higher aroma scores than PET bottle during storage which might be due to slower degradation of volatile aromatic compounds in glass bottles. The overall acceptability scores of appetizer decreased with the advancement of storage period which might be due to the loss in colour, body, flavour compounds and uniformity of the product during storage. The decrease in various sensory characteristics scores was more pronounced under ambient storage conditions than refrigerated storage conditions which might be due to the better quality of the appetizer during storage as a result of slower rate of deteriorative chemical reactions. These above results for various sensory parameters are in contrast with the findings of Sharma et al. (2002) in plum appetizer, Hamid and Thakur (2017) in mulberry appetizer and Thakur et al. (2017) in wild pomegranate appetizer.

**Conclusion**

Wild prickly pear appetizer was developed by mixing 35 per cent juice, 45 °B TSS and with a spice extract of cardamom (1 g), cumin (2.5 g), black pepper (2.5 g), common salt (5 g), black salt (5 g) then straining and mixing the extract in 200 ml of water, along with mint extract (10 ml) and ginger juice (15 ml). During six months of storage no much changes were observed in various physico-chemical and sensory parameters of appetizer. The wild prickly pear appetizer could be stored safely for a period of six months under both storage conditions (ambient and refrigerated) and packaging materials like PET and glass bottles. However, the best quality of this beverage could be maintained in glass bottle stored under refrigerated storage conditions as compared to PET bottle.

**REFERENCES**