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Utilization of *Glycyrrhiza glabra* for preparation of herbal aonla ladoo

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Abstract
Glycyrrhiza glabra called *yashtimadhu* in Sanskrit/Ayurveda, Mulethi in hindi and liquorice in english, is a ligneous perennial shrub. Glycyrrhizin is the principle component to which the sweetness and medicinal properties of mulethi are attributed. High temperature during processing has no effect on these active constituents. Hence attempt was made to utilize mulethi roots powder for preparation of herbal aonla ladoo. Mulethi roots were processed to prepare powder and herbal aonla ladoo using mulethi powder (2, 4 and 6%) were developed and evaluated. On the basis of sensory analysis, herbal aonla ladoo using mulethi powder (2%) was found most acceptable. The freshly prepared herbal aonla ladoo containing mulethi powder was analyzed for various chemical characteristics. The moisture content (35.8%), water activity (0.76), total soluble solids (59.9%), total sugars (53.9%), reducing sugars (29.9%), titratable acidity (1.49%), ascorbic acid (254 mg/100 g), pectin (0.43%), total phenols (1.96 mg/g), antioxidant activity (57.8%)and non-enzymatic browning (0.16) were recorded for herbal aonla ladoo containing mulethi powder (2%). Thus, present study was first in its kind to determine overall acceptability, chemical composition and effect of storage period on chemical constituents of herbal aonla ladoo obtained from aonla fruits cv. Chakaiya and mulethi root powder.

Keywords: Herbal, Mulethi, Aonla, Chakaiya, ladoo, sensory characteristics

1. Introduction
Fruits are amongst the first food items known to be consumed prehistorically by human beings. Aonla or Indian gooseberry (*Phyllanthus emblica* L.) is one of the traditional fruits indigenous to India and is considered as "Wonder fruit for health" (Ganachari *et al.*, 2010) [16]. Aonla, a member of family Euphorbiaceae and sub family Phyllanthiodae, is native to India, Ceylon, Malaya and China (Mishra *et al.*, 2010) [31]. It is also known as Amalaki, Amla, Amlet, Amolphal, Aovla, Aurna, Chukna, Dhatriphala, Emblic myrobalan, Nelli and Sobju in different parts of the World (Agarwal and Chopra, 2004) [2]. The fresh fruits are not popular as a table fruit due to its high acidity and astringent taste (kumar and Nath, 1993) [26]. Further, aonla, being perishable, loses its nutritional value in absence of proper post-harvest technology; therefore, it is not popular as a table fruit, but has a great potential in processed forms. Several value added products have been developed from aonla such as pickles, preserve (murrabba), candy, sauce, chutney, jam, jelly, spread and ladoo. Aonla ladoo is prepared from aonla shreds. It is ball-shaped, exceedingly sweet, highly flavourful and easily masticated product. Expanding knowledge of the role of physiologically active food components, from both plant (phytochemicals) and animal (zoo-chemicals) sources, has notably changed the role of diet in health. This has led to the development of a new generation of foods termed functional foods. Functional foods are generally described as foods and beverages that provide health benefits beyond their inherent nutritional value. Increased consumer interest in improving overall health and reducing risk for specific diseases has fueled the demand for foods that provide health benefits beyond their traditional nutritional value (i.e., so-called functional foods). Nutritional and medicinal qualities of ladoo can be enriched by addition of ingredients such as medicinal plant extract or powder (Reddy *et al.*, 2005) [32]. Herbal inclusion not only gives medicinal qualities but can also give new flavor to the product.
Medicinal plants are most exclusive sources of life giving drug for majority of the World population. *Glycyrrhiza glabra* called *yashtimadhu* in Sanskrit/Ayurveda, Mulethi in hindi and liquorice in english, which means the sweet healer. Mulethi is a ligneous perennial shrub and is an important medicinal plant with multiple uses. It is most commonly employed due to its medicinal, aromatic and sweetening agent properties. It is in great demand in India and is imported annually to the tune of 5000 tons from south Europe, Iraq, Syria, turkey and Russia, which are major producers of this crop (Thangene *et al*., 1998) [50]. The commercial important part of plant is its roots and underground stem.

Glycyrrhizin is the principle component to which the sweetness and medicinal properties of mulethi are attributed. Glycyrrhizin is triterpene saponin, which is fifty times sweeter than sucrose, and is used as a sweetener in confectionery and tobacco industries. Roots and rhizomes of *Glycyrrhiza glabra* have been employed clinically for centuries for their anti-inflammatory, anti-ulcer, expectorant, antimicrobial and anxiolytic activities (Asl and Hosseinzadeh, 2008) [5]. Liquorice has been shown to have great antioxidant, free radical scavenging (Di Mambro & Fonseca, 2005) [31] and anticonvulsant activities (Nassiri-Asl *et al.*, 2007) [34]. The present study was thus taken up todetermine chemical composition and overall acceptability of herbal aonla ladoo obtained by utilization mulethi roots powder.

Materials and Methods

Roots of mulethi were cleaned, washed and dried in cabinet dryer at 50°C. Dried roots were ground to fine powder (Plate No. 1) in a hammer mill, packed in LDPE bags and stored at room temperature for use in aonla ladoo. Mulethi roots powder (2, 4 and 6%) was mixed with aonla pulp for preparation of herbal aonla ladoo. Aonla ladoo (control) were prepared by using 1 kg aonla pulp, 750 g sugar and 1 g cardamom powder (small) as per the procedure shown in flow sheet (Fig. 1). On basis of sensory evaluation, optimum quantity of mulethi roots powder was standardized for the preparation of herbal aonla ladoo. For processing aonla ladoo, the mixture was cooked till desired consistency was obtained. The product was then cooled, rolled into ladoo and packed in polypropylene (PP) boxes. The freshly prepared herbal aonla ladoo containing mulethi powder was analyzed for various chemical characteristics. Total soluble solids (TSS) were estimated at ambient temperature by hand refractometer (0-32%) and the values were expressed as percent TSS. Ascorbic acid was analyzed according to AOAC (1990) [1] method. Non- enzymatic browning (NEB) was determined according to the method of Ranganna (2008) [40]. Total phenols were analyzed as per the methods given by Amorium *et al.* (1997) [3], while organoleptic evaluation by using 9 point hedonic scale. The moisture content of herbal aonla ladoo was determined by Dean and Starkmethod. The water activity of processed products was recorded by water activity meter (Labswift aw, Novasina, Switzerland). The instrument was calibrated with water activity meter calibration humidity salts (11, 58 and 84%). Sugars were estimated by the method of Hulme and Narain (1931) [18]. Total phenols (expressed as tannins) were estimated by the Amorium *et al*. (1997) [3]. Antioxidant activity was measured using stable 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical as per the method described.

Results & Discussion

Organoleptic quality of herbal aonla ladoo: The data pertaining to effects of incorporation of various levels of supplements (mulethi) on sensory attributes of aonla ladoo variants has been shown in Table 1. Aonla ladoo were evaluated for sensory attributes *viz.*, colour and appearance, taste, texture, mouthfeel and overall acceptability. Mean score for colour and appearance, taste, texture, mouthfeel and overall acceptability of control aonla ladoo were 8.2, 8.1, 8.0, 8.0 and 8.0, respectively. In herbal aonla ladoo, no significant change in mean score of various sensory attributes was noticed with incorporation of mulethi powder upto 2%. However, the mean score for sensory attributes *viz.*, colourand appearance taste, texture, mouth feel and overall acceptability of herbal aonla ladoo containing 4 and 6% mulethi powder, respectively was significantly lower than control. Overall acceptability scores indicate that herbal aonla ladoo containing4 and 6% mulethi powder, respectively were "Neither liked nor disliked". Thus, formulations containing 2% mulethi powder were selected for preparation of herbal aonla ladoo.

Chemical constituents of herbal aonla ladoo

Changes in Moisture%, Water activity, total soluble solids (TSS), Total sugar, Reducing Sugar, Titratable acidity, ascorbic acid, total phenols, non-enzymatic browning, Antioxidant activity and pectin in herbal aonla ladoo during three months storage period in present study have been presented in Tables 2.The moisture content of herbal aonla ladoo containing 2% mulethi was found decreased significantly during three months storage. This may be due to evaporation of moisture from the samples at room temperature during storage. Singh *et al*. (2010) [45] reported a decline in moisture content of intermediate moisture baby corn during storage. Singh *et al.* (2012) [44] also reported decrease in moisture content in aonla supari during 135 days of storage period. Water activity of herbal aonla ladoo ranged from 0.76 to 0.69 during three months of storage. The progressive decrease in a_w of herbal aonla ladoo during storage might be due to loss of moisture content from the samples. Ayub and Alam (2002) [6] reported decline in a_w of dehydrated sweetened guava slices. Singh *et al.* (2012) [44] also reported decline in water activity of aonla supari during 135 days storage period.

Total soluble solids were found to increase significantly in herbal aonla ladoo during three months storage. This might be due to conversion of polysaccharides into soluble sugars by hydrolysis process and reduction in moisture content of the product during storage. Similar results were reported by Ayub *etal*. (2005) [7] in sweetened guava slices, Daisy *et al*. (2007) [11] in aonla preserve, Ram *et al*. (2011) [39] in aonla bael blended RTS beverage and Choudhary *et al*. (2012) [10] in aonla nectar. There was a gradual and significant increase in total sugars of herbal aonla ladoo with the advancement of storage period. The increase in level of sugars can be attributed to loss of moisture from the products and hydrolysis of starch and pectin into simple sugars. Similar finding were reported by Ram *et al*. (2011) [39] in aonla bael blended RTS beverage and Choudhary *et al*. (2012) [10] in aonla nectar, Gaikwad *et al*. (2013) [15] in aonla ginger RTS beverage and Patel *et al.* (2013) [37] in aonla murabba. Reducing sugars of herbal aonla ladoo ranged from 28.2to 31.2 during three months of storage. The increase in reducing sugars corresponds to increase in total soluble solid (TSS). Thus, it could be due to moisture loss and inversion of non-reducing into reducing sugars by hydrolysis. Rani and Bhatia (1986) [41] also showed an increase in reducing sugars during 24 weeks storage of Bagughosa preserve, which was ascribed to increased inversion of sugars. Similar results were also reported by Mir and Nath (1993) [30] in fortified mango bar, Sivakumar *et al.* (2007) [46] in guava toffee, Nagpal and Rajyalakshmi (2009) [33] in bael-citrus fruit blend and Panwar (2014) [36] in IMF aonla segments and aonla candy**.** Gradual and significant increase in titratable acidity of herbal aonla ladoo was observed during three months storage. The increase in acidity might be due to conversion of sugar into acids (Manivasgan *et al*., 2006) [28], degradation of polyphenols and conversion of proteins to amino acids. Pectic acid has also been reported to increase the acidity in fruit products; hence, degradation of insoluble pectic substances into soluble pectate

might also have contributed towards an increase in acidity of some products. These results are in accordance with those of Hussain *et al*. (2004) [20] in osmotically dehydrated banana slices, Kaikadi *et al*. (2006) [22] in ber candy, Manivasagan *et al*. (2006) [28] in karonda candy and Nayak *et al*. (2012) [35] in aonla candy. Ascorbic acid content decreased significantly in herbal aonla ladoo during three monthsstorage period. This loss of ascorbic acid could be attributed to oxidation of ascorbic acid to dehydro-ascorbic acid with passage of time. Similar findings have been confirmed by reduction by Tandon *et al.* (2003) [49] in aonla candy, Muhammad *et al.* (2008) [32] in apple jam, Hussainand Shakir (2010) [19] in apricot and apple jam, Bhuiyan (2012) [8] in fresh hog plum chutney, Choudhary *et al.* (2012) [10] in aonla syrup, Souad *et al.* (2012) [47] in watermelon waste jam and Vikram*et al.* (2012) [50] in aonla herbal jam. The ascorbic acid content was found to decrease more rapidly inthe initial stages but the decrease was slow in the later stages with increase in storage period.Similar result was reported by Patel *et al*. (2013) [37] in aonla murabba during 180 days of storageperiod. A non-significant decrease in pectin content of herbal aonla ladoo was noticed duringfirst month of storage period. However, decrease in pectin content of herbal aonla ladoo was found significant in later months of storage. This decrease in pectin content might be due to degradation of pectin into pectic acid during storage. Similar results were reported by Mehta *et al*. (2005) [39] in galgal peel candy and Patel *et al*. (2013) [37] in aonla murabba. A significant decrease in total phenols of herbal aonla ladoo was recorded during three months storage. The decrease in total phenols during storage might be due to their condensation into brown pigments (Fennema, 1976) [14]. The phenolic acids are oxidized to 0- semiquinone residuals or 0-quinone molecules, which are reactive to give brown products of high molecular weight. Decrease in total phenols during storage was also reported by Kannan and Thirumaran (2001) [23] in jamun products (RTS drink, squash, syrup and jam), Kaushik *et al.* (2002) [24] in bael preserve, Deka *et al.* (2005) [12] in mango-pineapple based spiced RTS drink, Punam *et al*. (2009) [38] in bael-mango RTS drink and squash. Non-enzymatic browning increased significantly in herbal aonla ladoo with the advancement in three months storage period. This might be due to condensation of tannins into brown pigments and inversion of non-reducing to reducing sugars, which participated in maillard browning. Browning index of ash gourd candy (Srivastava *et al*., 2006) [48] and karonda candy (Manivasagan *et al*., 2006) [28] also increased during storage. Similar increase in browning index during six months of storage was also reported in IMF aonla segments and aonla candy by Panwar (2014) [36]. Antioxidant activity decreased significantly in aonla ladoo variants during three months storage period. Phenolic compounds and ascorbic acid content have been proved to be responsible for the antioxidant activity of aonla fruit (Kumar *et al.*, 2006 ; Sabu and Kuttan, 2002; Anila and Vijayalakshmi, 2003) [25, 43, 4]. This loss in antioxidant activity could be attributed to oxidation or loss of ascorbic acid and phenolic compounds in herbal aonla ladoo with the passage of time. Similar results were reported by Kumari (2014) [27] in rainy and winter season guava fruits during two weeks storage.

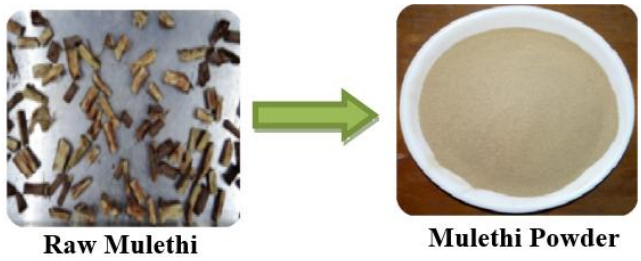

Plate 1: Flowchart for processing of Mulethi powder

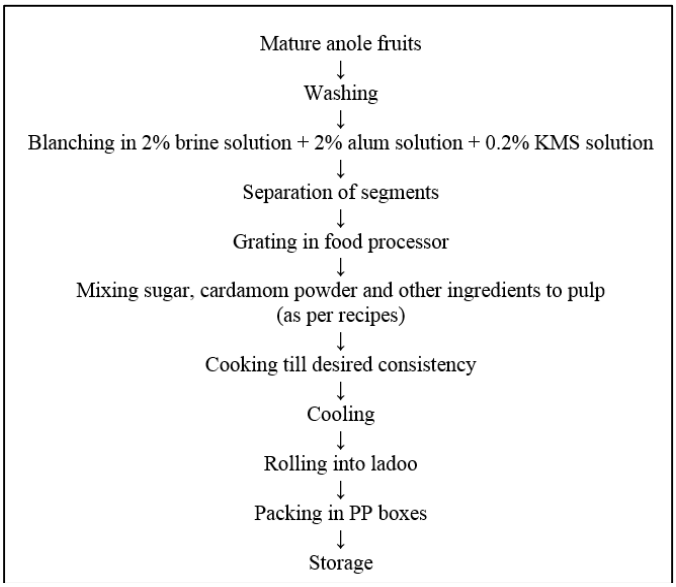

Fig 1: Flow sheet for preparation of aonla ladoo

Table 1: Organoleptic quality of herbal aonla ladoo

Treatments (%)		Characters				
		Colour & appearance	Taste	Texture	Mouth feel	Overall Acceptability
Satavari	0	8.2	8.1	8.0	8.0	8.0
	2	7.8	7.9	7.6	7.7	7.7
	4	7.8	7.5	7.4	7.5	7.5
	6	6.0	5.6	5.3	5.4	5.6
	CD at 5%	0.42	0.32	0.45	0.46	0.43

Table 2: Effect of storage period on chemical constituents of herbal aonla ladoo

Herbal aonla ladoo	Storage period (Months)				CD at 5%
	0	1	2	3	
Moisture %	35.8	34.6	31.7	28.2	0.9
Water activity	0.76	0.74	0.73	0.69	0.02
TSS	59.9	64.1	67.3	71.0	0.44
Total Sugar	53.9	54.7	55.6	56.9	0.35
Reducing Sugar	29.9	30.7	32.1	33.4	0.56
Titratable acidity	1.49	1.53	1.56	1.62	0.31

Ascorbic acid (mg/100g)	254	219	197	187	2.7
Total phenols	1.96	1.87	1.78	1.60	0.1
NEB	0.16	0.19	0.27	0.34	0.03
Antioxidant activity	57.8	48.1	39.1	31.6	0.78
Pectin %	0.43	0.43	0.42	0.38	0.01

Conclusion

It can be concluded from the present investigation that among different levels of supplement mulethi (2%) was found to be the most acceptable formulations for preparation of herbal aonla ladoo. The moisture content (%), water activity (aw), ascorbic acid, pectin, total phenols &antioxidant activity decreased significantly in herbal aonla ladoo during three months of storage. While TSS, total sugar, reducing sugars, titratable acidity and non-enzymatic browning increased significantly in herbal aonla ladoo during three months of storage. Thus, present study was first in its kind to determine overall acceptability and chemical composition of herbal aonla ladoo obtained from aonla fruits cv. Chakaiya and mulethi root powder.

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