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Effect of storage period on chemical parameters and sensory admissibility of cookies incorporated with stem powder of giloy (*Tinospora cordifolia*)

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Abstract
In present investigation cookies were developed by incorporation of giloy stem powder and effect of storage on cookies qualities were analyzed by chemical parameters [(Moisture %, Peroxide value (PV) and Thiobarbituric Acid Value (TBA)] and sensory characteristics. The result showed gain in moisture content from 1.82 ±0.04 % to 4.31 ±0.23 %, peroxide value from 1.48±0.17 to 5.25±0.09 (meq O_2 /kg fat) and TBA value from 0.06±0.01 to 0.29±0.03 (mg malonaldehyde /kg sample) respectively, and decrement in sensory parameters in giloy cookies during storage of 90 days. It was revealed that giloy cookies significantly more stable than control cookies and accepted by consumers up to 90 days of storage. Hence incorporation of giloy stem powder as a source of phytochemical could be an innovative approach to enhance its chemical stabilities and maintain sensory qualities.

Keywords: Giloy (*Tinospora cordifolia)*, cookies, shelf life, sensory characteristics

Introduction
Cookies are bakery snack consumed universally, rich in sugar and fat, long shelf life, liked by all range of people and reckoned to be a perfect vehicle for conveying nutritionally important helpful constituents. The adoption of blending ingredients for cookies should be promptly accessible, socially admissible and support high quality of nutrition **(**Okpala *et al.,* 2012) [13]. Many scientists worked out by substituting the wheat flour with other ingredients, fortification or supplementation of cookies by developing value added cookies biscuits (Manley, 2000; Ansari and Kumar, 2012) [9, 2] that have advantageous upshot on health and able to lessen the chance of diseases (Vitali *et al.,* 2008) [23]. As cookies are fat rich product and highly susceptible to rancidity or oxidation the quality of food degenerates by oxidation and leads to off flavor, bad impact on health and economic depreciation (Ullah *et al.,* 2003) [22]. Antioxidants have gained considerable attentiveness to ward off oxidation of fat rich food products. TBHQ (tertiary butyl hydroquinone), PG (propyl gallate), BHT (butylated hydroxyl toluene) and BHA (butylated hydroxyl anisole) are being commonly used as synthetic antioxidants that have suspected to have carcinogenic activity and create health problems (Sundaram, 2012) [19] Spices, herbs and other plants are the good source of natural antioxidants considered to be safer than synthetic one. Global trend shifting from synthetic to natural that is "Return of Nature" (Shivatare *et al.,* 2013) [18]. One of the nature's fortunes, giloy (*Tinospora cordifolia*) a precious common herb and multipurpose medicinal plant regarded as "eternal nectar". It has been used as source of natural antioxidants, the presence of high levels of polyphenolic contents could be a possible reason behind the higher amount of antioxidant activity (Balkrishna *et al*., 2016) [6].
Attempts has been made by many scientists to develop cookies by incorporation of variety of plants products as source of natural antioxidant such as extract of chokeberry poly-phenols (Bailek *et al.,* 2016) [7], rice bran oil (Sharif *et al.,* 2003) [17], cereal bran (Nagi *et al.,* 2012) [11] and pineapple powder (Thivani and Kanimoly, 2016) [21] to enhance the shelf life.
With this context present study was designed to check the ability of giloy (*Tinospora cordifolia*) stem powder incorporated in cookies to enhance the storage life. Changes during storage were accessed by chemical and sensory analysis of the cookies.

Material and Methods
Materials
For cookies preparation ingredients used Table 1, were purchased from the local market of Varanasi (U.P). Powdered giloy or *Tinospora cordifolia* (TC) was prepared, in the centre of food science and technology, BHU, Varanasi, from the stem over Neem (*Azardica indica*)

and that was procured from the botanical garden of botany department, BHU. All chemicals and reagents used were of analytical grade.

Methods

Preparation of cookies

Giloy (*Tinospora cordifolia*) stem powder was used in formulation of cookies at 0 (control cookies and 8% (Giloy cookies) substitution of wheat flour. The cookies were prepared by the method of AACC Method (2000) [1] with little modification as shown in fig-1

Table 1: Formulation of cookies

Ingredients (grams)	Control Cookies(CC)	Giloy cookies (TCC)
Refined wheat flour (Maida)	1000	920
Margarine	400	400
Powdered sugar	600	600
Giloy powder	0	80
Baking powder	12.5	12.5
Baking soda	12.5	12.5
Water (ml)	5 0	5 0

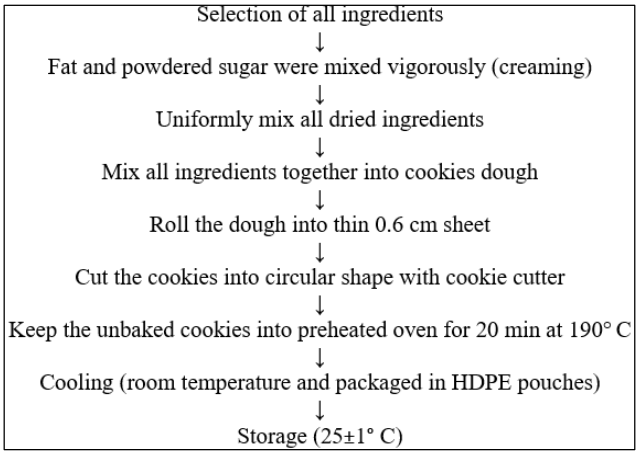

Fig 1: Flow chart of preparation of cookies

Fig 2: Cookies packed in High density polyethylene (HDPE)

Storage

The prepared cookies sample were packed in HDPE and stored at 25±1º C. Initially fresh samples were analysed and further analyzed after each 45 days interval up to 90 days.

Sensory characteristics

Sensory evaluation was done as described by Nwakalor (2014) [12] using sensory parameters such as flavor, color & appearance, after taste, texture & overall acceptability of cookies by 15 semi skilled participants of Centre of Food Science and Technology, BHU, Varanasi, on 9-point Hedonic scale level from 1 (disliked extremely) to 9 (liked extremely).

Chemical properties

Moisture content

Grounded sample of cookies weighed 2-3g was subjected to oven 105±2°C for moisture loss until the constant weight was obtained and further moisture % was calculated and expressed on wet basis (AOAC, 2000) [3].

Peroxide value (PV)

Peroxide value was estimated by the AOCS (1990) [4] method.4–5g of sample was taken in iodine flask. 20 mL of chloroform followed by 30ml of glacial acetic acids were added. Sample was kept in dark for 20 min after adding 1mL of saturated K.I (potassium Iodide). After 20 min, 50mL distilled water was added to the sample followed by 1 or 2 drops of starch indicator and titrated against sodium thiosulphate solution (0.02N) to a colorless end point. The PV was expressed as milli equivalents of oxygen per kilogram fat.

Thiobarbituric Acid (TBA) Value

TBA value of the sample was estimated by the procedure given by Tarladgis *et al*. (1960) [20]. 10g of oil/fat sample was putted to an Iodine flask and 25 mL of benzene was mixed followed by 20 ml aqueous TBA solution (0.67 % w/v in water) and shaken in a mechanical shaker for 2 hours. The aqueous layer was separated out using separating funnel and heated over water bath for 35 minutes. Optical density of red colour was noted at wavelength of 540 nm. TBA value was expressed as mg of malonaldehyde / kg sample.

Statistics

Graph Pad Prism 5 software was used for data analysis. Data were presented as Mean ± Standard (M±SD) deviations and significant level was consider at $P<0.05$.One-way ANOVA with Bonferroni test were used to analyze data using Graph Pad Prism.

Results and discussion

Effect of storage on sensory properties

Scored results of sensory acceptability with all parameters (flavor, after taste, color & appearance, texture and overall acceptability) during storage are represented in Table-2 found to be declined with increasing storage period but both the cookies were accepted by the consumers during storage of 90 days. When comparing the results of control cookies (CC) and giloy cookies (TCC) from 0 to 90 days non significant change was noticed for all sensory parameters. And similar pattern of decrement in the sensory quality with increase in storage period (up to 9 months) of composite cereal bar was noticed by Padmashree *et al*. (2012) [14].

Table 2: Effect of storage on sensory attributes

Storage time (In days)	Flavor		After Taste		Color & Appearance		Texture		Overall Acceptability	
	CC	TCC	CC	TCC	CC	TCC	CC	TCC	CC	TCC
0	7.80 ± 0.42	7.50 ± 0.53	7.40 ± 0.52	7.30 ± 0.48	7.80 ± 0.42	7.70 ± 0.48	7.40 ± 0.52	7.30 ± 0.48	7.50 ± 0.53	7.40 ± 0.52
45	7.20 ± 0.63	6.90 ± 0.32	7.20 ± 0.63	6.90 ± 0.57	7.40 ± 0.52	7.30 ± 0.48	7.10 ± 0.57	6.80 ± 0.42	6.90 ± 0.57	6.80 ± 0.63
90	6.50 ± 0.53	6.30 ± 0.48	6.60 ± 0.70	6.50 ± 0.53	7.10 ± 0.74	7 ± 0.67	6.50 ± 0.53	6.40 ± 0.52	6.50 ± 0.53	6.40 ± 0.52

Data are (Mean ± SD); TCC compared with CC; where CC = control cookies and TCC= giloy cookies

Effect of storage on chemical properties

Effect on moisture

The moisture percentage increased from 1.51±0.04 to 4.27± 0.12 % in control cookies (CC) and from 1.82±0.04 to 4.32±0.23 in giloy cookies (TCC) depicts in Fig 3, during the storage of 0 to 90 days. The results depicts that moisture content of control cookies significantly lower than optimized cookies up to the storage of 45 days and at 90th day there was no significant change was noticed in both the cookies. Similar findings of moisture gain in cookies during storage were noticed in previous studies by Nagi *et al.* (2012) [11].

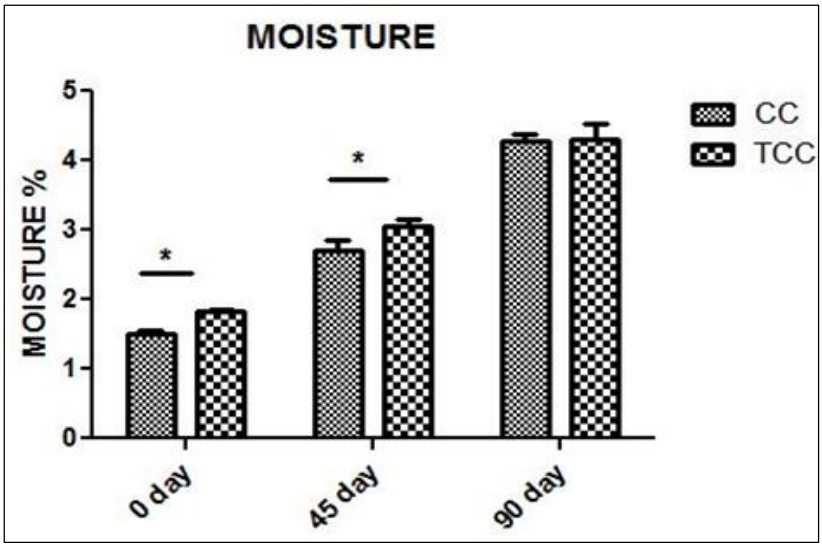

Fig 3: Effect of storage period on moisture% of cookies

Effect on peroxide value

The values presented in Table and Fig 4, clearly depicts that the peroxide values of giloy cookies 1.48±0.17 to 5.25±0.09 and control cookies 1.67±0.06 to 6.30±0.37 increases with increase in storage period from 0 to 90 days respectively. And peroxide value for TCC was significantly (p<0.05) lower than CC at 45 and 90 days of storage. This outcome is well supported with the observation of Reddy *et al.* (2005) [16] and Magda *et al.* (2008) [8] who noticed that peroxide values were lower than that of control.

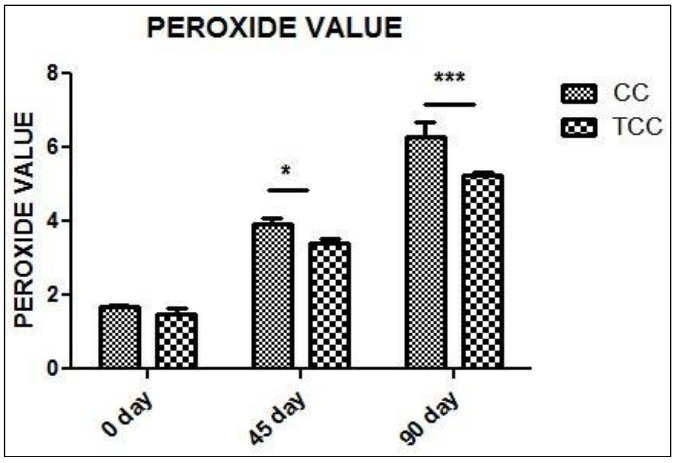

Fig 4: Effect of storage period on peroxide value of cookies.

Effect on TBA value

From the data represented in Fig 5 and Table 3, it was noticed that with increasing storage period elevates the TBA value of both cookies. The TBA value for giloy cookies (TCC) were 0.06±0.01, 0.19±0.02 and 0.29±0.03 and for control cookies (CC) were 0.08±0.02, 0.23±0.01and 0.38±0.01 at 0, 45th and 90th days of storage, respectively. There was no significant change was observed in TBA value of TCC and CC from 0 to 45 days of storage and on 90th day TBA value of CC was significantly (P<0.05) higher than TCC. Similar finding was studied by Misan *et al.* (2011) [10] and Bajaj *et al.* (2016) [5] for cookies. The lower value of TBA delayed the onset of rancidity in cookies (Sharif *et al.*, 2003) [17] this might be due the antioxidant property of stem powder (TC) in optimized cookies (Polu *et al.*, 2017) [15].

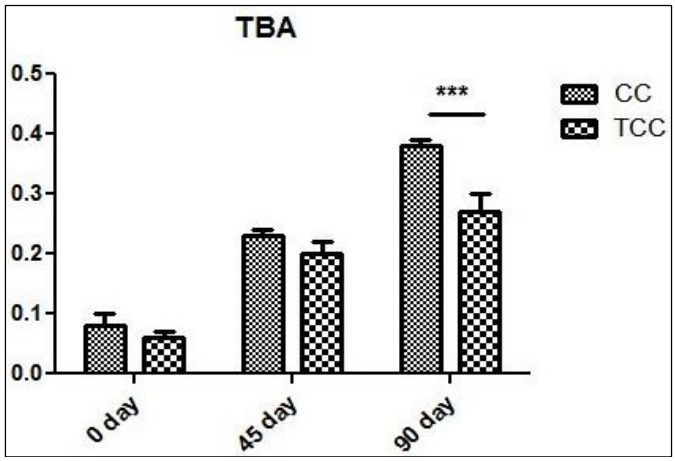

Fig 5: Effect of storage period on TBA value of cookies

Table 3: Effect of storage on Chemicals parameters

Storage period (In days)	Chemical Analysis					
	Moisture%		Peroxide Value (meq O_2/kg fat)		Thiobarbituric acid (mg malonaldehyde/kg fat)	
	CC	TCC	CC	TCC	CC	TCC
0	1.51±0.04	1.82±0.04	1.67±0.06	1.48±0.17	0.08±0.02	0.06±0.01
45	2.71±0.14	3.05±0.11	3.93±0.15	3.41±0.10	0.23±0.01	0.19±0.02
90	4.27±0.12	4.31±0.23	6.30±0.37	5.25±0.09	0.38±0.01	0.29±0.03

Data are (mean ± SD); TCC compared with CC, where CC = control cookies and TCC= giloy cookies

Conclusion

Effects of storage on sensory admissibility of giloy cookies were non-significant with control cookies. Use of giloy stem powder delay the onset of oxidation of giloy cookies as TBA value and peroxide value was significantly lower than the values of control cookies during storage. Therefore giloy stem powder can be regarded as useful component to increase the shelf life without using any synthetic preservatives and also accepted by the consumers.

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