RESEARCH PAPER

FOOD SCIENCE
RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 8 | Issue 2 | October, 2017 | 254-259
DOI : 10.15740/HAS/FSRJ/8.2/254-259

Tomato pomace as a functional ingredient in cookie making

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Tomato pomace, a by-product of tomato juice industry, is a rich source of fibre and polyphenols. Also in view of the antioxidant property of pomace, it would play an important role in prevention of diseases. Tomato pomace procured from Food processing training centre (FPTC) SKUAST-K, Shalimar, contained 87.20% moisture, 1.10% ash and 6.20% of dietary fibre. Finely ground tomato pomace was incorporated in wheat flour at 5%, 10%, 15 %, 20% and 25% levels for development of cookies. Water absorption increased significantly from 58.20% to 67.30% with increase in pomace from 0% to 25%. Dough stability decreased and mixing tolerance index increased, indicating weakening of the dough. Resistance to extension values significantly increased from 330 to 625 BU whereas extensibility values decreased from 120 to 42 mm. Cookie were prepared from blends of wheat flour containing 0–25% tomato pomace. The diameter and spread factor of cookies increased from 53.25 to 53.80 mm and 77.1 to 81.02, respectively with increase in pomace content from 0% to 25%. The thickness of cookies decreased with increase in pomace levels. Volume of cookies decreased with incorporation of tomato pomace. Cookies prepared from 25% of tomato pomace had dietary fibre and total phenol content content of 10.23% and 6.20 mg GAE/100g as compared to control indicating that tomato pomace can serve as a good source of both polyphenols and dietary fibre.

Key Words : Tomato pomace, Farinograph, Cookie, Dietary fibre, Total phenol content

How to cite this article : Bhat, Mudair Ahmad, Ahsan, Hafiza, Masoodi, Lubna, Hameed, Omar Bin and Saleem, Rehana (2017). Tomato pomace as a functional ingredient in cookie making. *Food Sci. Res. J.,* **8**(2): 254-259, **DOI : 10.15740/HAS/FSRJ/8.2/254-259**.

INTRODUCTION

Dietary fibre functions as a bulking agent and increases the intestinal mobility and moisture content of the feces (Forsythe *et al.*, 1976). Dietary fibre consists of cellulose, hemicelluloses, lignins, pectins, gums etc. (Gallaher and Schneeman, 2001). Insoluble fibre enlarges the volume of food, shortens the period of its pas- sage through the digestive tract and improves the intestinal peristaltic. It is metabolized along with vegetable fibre by micro-organisms of the colon and appendix only. A part of fibre, especially resist- ant starch, is partly or fully broken into volatile oily acids with a short chain – acetic, propionic, and particularly butyric, which prevents from the quick multiplication of cancer cells of the intestinal wall (Hollmann and Lindhauer, 2004). The consumption of food with a higher content of fibre shows profitable physiological effects and health benefits, confirmed by a plenty of authors (Buttriss and Stokes 2008 and Borchani *et al*., 2011). Insoluble fibre (cellulose and hemicelluloses) is an effective laxative whereas soluble fibre lowers plasma cholesterol levels and helps normalize blood glucose and insulin levels, making these kinds of polysaccharides a part of dietary plans to treat cardiovascular diseases and type 2 diabetes.

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Numerous studies have been carried out in order to replace wheat with flour made from waste from fruit residues in the preparation of bakery products such as biscuits like cookies due to economic constraints, business requirements, new consumption trends, and specific eating habits (Aquino *et al.*, 2010 and Perez and Germani, 2007). Fruit residues can be important sources of nutrients and, to satisfy consumer demand for healthier products, many food industries are finding ways to add functional ingredients to their products (Assis *et al.*, 2009). According to Aquino *et al.* (2010), when added to foods, such ingredients are associated to healthy products by customers since they are able to modify/enhance the taste, texture, aroma, colour, and nutritional value of the products produced. Santucci *et al.* (2003) stated that the mixture of flour made from unconventional products with wheat flour improves the nutritional quality of cookies and may even improve their palatability making them more accepted by consumers. Souza *et al.* (2008) concluded that the flour prepared from passion fruit shell can be used in the enrichment of products such as breads, cookies, and Granola bars improving their nutritional and technological qualities, besides being an alternative to reduce the by product waste in the food industry. During tomato processing a by-product, known as tomato pomace, is generated. This by-product represents about 4% of the fruit weight (Del-Valle *et al.*, 2006). Tomato pomace consists of the dried and crushed skins and seeds of the fruit (Tadeu-Pontes *et al.*, 1996). Dried tomato pomace, a fruit industry by-product, is considered as a potential food ingredient having dietary fibre content of about 38.20 % and total phenolics content 65.30 mg GAE/ 100g. Tomato pomace is a rich source of bioactive compounds such as high valuable oils, dietary fibre, vitamins and secondary metabiolites (Bildstein *et al.*, 2009). Keeping in view the above mentioned nutritional value of tomato pomace and its subsequent drying to reduce its disposal problem, it can be used in different products after its drying.

METHODOLOGY

Materials :

Dried tomato pomace was procured from Food Proceesin training centre (FPTC), Division of Post Harvest technology, SKUAST-Shalimar. Tomato pomace consists of the dried and crushed skins and seeds of the fruit were ground to pass through 150 µm sieve. The commercial wheat flour having 11.10 % moisture, 0.68 % ash and 10.65 % protein was procured from the local market.

Chemical analysis :

Dried tomato pomace was analysed for moisture, ash, protein and fat contents as per the standard AACC methods (2000). Nitrogen content was estimated by micro Kjeldhal method and was converted to protein using factor 6.25. Total dietary fibre (TDF), soluble (SDF) and insoluble (IDF) dietary fibre contents were estimated according to dietary fibre system (fibraplus DF). For water holding capacity determination, 1 g of tomato pomace powder was mixed with 50 ml of distilled distilled water vigorously for 1 min and then centrifuged for 15 min at 10,000g at 20° C. The supernatant was discarded and the tube was kept inverted for 10 min. Moisture content of the precipitate was determined (Chen *et al.*, 1988b). All analysis for the samples were carried out in triplicate and average value was expressed.

Rheological characteristics :

Tomato pomace blends at 0%, 5%, 10% 15%, 20 % and 25 % levels were prepared by replacing wheat flour. The effect of tomato pomace on the mixing profile of the dough was studied using farinograph (Brabender, Duisburg, Germany) according to the standard AACC methods (2000).

Baking tests :

Cookies were prepared from blends containing 0%, 10%, 15 %,20% and 25% of tomato pomace. The formula included 70 g sugar, 60 g egg, 80 g shortening, 30 g milk powder, 2.0 g baking powder and 30 ml water. After weighing the ingredients accurately, bakery shortening and sugar were creamed in a mixer with a flat beater for two minutes at slow speed, followed by addition of egg white. Creaming continued till foaming was occurred. The wheat flour, milk powder and baking powder were added to the creaming mass and mixed to a homogeneous mixture for five minutes at high speed. Standardized amount of water was added and the dough was kneaded for 7 min. The kneaded dough was sheeted to a thickness 6.9 mm using cookie table. The cookies were cut with cookie die to desired diameter and transferred to a lightly greased aluminium baking tray. The cookies were baked at 150° C for 15 min in a baking oven The baked cookies were cooled for 1-2 min and packed in high density polyethylene (HDPE) bags for further analyses and storage studies. Cookies were stored at ambient temperature for further analysis and storage studies.

Physical characteristics of cakes :

Diameter :

For the determination of the diameter, six cookies were placed edge to edge. The total diameter of the six cookies was measured in mm by using a ruler. The cookies were rotated at an angle of 90^0 for duplicate reading. This was repeated once more and average diameter was reported in millimeters (AACC, 2000).

Volume of cookies is defined as the area of the cookies multiplied by thickness.

Volume = $D^2 \times \pi \times T / 4$ where, T = Thickness of cookies (average) and D = Diameter (average). Thickness, six cookies were placed on top of one another. The total height was measured in millimeters with a ruler. The measurement was repeated thrice to get an average value and results were reported in mm (AACC, 2000).

Spread factor was calculated as diameter (length) to thickness ratio (AACC, 2000).

Spread factor = Diameter / Thickness x correction factor x 10

Correction factor = 1.0

Sensory analysis :

Sensory evaluation of cookies were carried out by six panelists on a five point hedonic scale for different parameters such as colour, taste, texture, appearance and overall acceptability.

Statistical analysis :

Experimental data was subjected to the statistical analysis following analytical procedures as described by Gomez and Gomez (1984). Level of significance used for F; and t; tests were $p \leq 0.05$ from the table given by Fisher (1970) and the data collected was subjected to statistical analysis using statistical software “STATISTICA-AG” from Stat Soft (USA) licensed to FOA, Skuast-Kashmir, Wadura campus.

Determination of total phenol content :

Total phenol content of sample was determined by spectrophotometric method given by Thimmaiah (1999).

500 mg of sample was grinded with a pestle and mortar and ten times volume of 80% ethanol was added to it. The homogenate was centrifuged at 10,000 rpm for 20 mints and the supernatant was saved. The residue was re-extracted five times with the 80% ethanol, centrifuged and the supernatant was pooled. The supernatant was evaporated to dryness and the residue was dissolved in a known volume of distilled water (5 ml). A 0.2 ml of aliquot was pipette out into test tubes and 3ml volume was made up with water. 0.5 ml Folin-Ciocalteu reagent was added to each tube. After 3 minutes 2 ml of 20 % sodium carbonate solution was added and mixed thoroughly. The tubes were placed for exactly one minute in boiling water followed by cooling. The absorbance was then measured at 650 nm using spectrophotometer (Double Beam UV-VIS spectrophotometer) against a reagent blank. A standard curve was prepared using different concentrations of gallic acid. From standard curve the concentration of phenols in the test sample was found and expressed as mg phenols per 100g gallic acid. Results were expressed as gallic acid equivalents (GAE)/ 100 g.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Chemical characteristics of tomato pomace :

The results of chemical analysis of tomato pomace is presented in Table 1. Tomato pomace had moisture and protein contents of 87.20 % and 4.32 %, respectively. The total dietary fibre content (TDF) was 6.20 % in tomato pomace. The soluble fibre content of 2.20 per cent and insoluble fibre content of 3.10 per cent. The water holding capacity for wheat flour and tomato pomace was 1.01 and 7.25 g water/g solid, respectively, indicating that the fibre had higher water holding capacity.

Table 1 : Proximate composition of tomato pomace

Sr. No.	Parameters	Percentage
1.	Moisture content	87.20
2.	Total ash	1.10
3.	Total protein	4.32
4.	Total dietary fibre	6.20
5.	Insoluble fibre	3.10
6.	Soluble fibre	2.20
7.	Water holding capacity (g H_2O/g solid)	7.25

Farinograph characteristics of wheat flour-tomato pomace blends :

Water absorption increased significantly from 58.20% to 67.30% with increase in pomace from 0% to 25%. Dough development time increased from 1.2 to 3.2 min and dough stability decreased from 40 to 2.3 min. An increase in the dough development time indicates that an increase in fibre content in the blends has slowed the rate of hydration and development of gluten. Mixing tolerance values increased from 30 to 100 BU, which is due to dilution of gluten protein with the fibre content. This may also be due to the interaction between fibrous materials and gluten, which affects the dough mixing properties as reported by Chen *et al.* (1988a).

Extensograph characteristics of wheat flour-tomato pomace blends :

With increase in tomato pomace content to 25%, Resistance to extension values significantly increased from 330 to 625 BU whereas extensibility values decreased from 120 to 42 mm. This may be either due to the dilution of gluten proteins or interactions between polysaccharides and proteins m wheat flour as reported by Chen *et al.* (1988a).

Baking characteristics :

Cookies were prepared by replacing wheat flour at 5%, 10%, 15%, 20% and 25 % levels of tomato pomace and the physical properties of cookies are presented in Table 2. As the concentration of tomato pomace increased from 0% to 25%, the diameter of the cookies increased from 53.25 to 53.80 mm and the thickness of the cookies decreased from 6.90 to 6.64mm. The increase in diameter was due to the fact that appreciable amounts of water could have strongly bound to the added fibre (tomato pomace) during baking, so less water was available for the development of starch-gluten network. This in turn reduces the dough viscosity which causes the cookie to spread at a faster rate. The spread factor of cookies enhanced with increase in pomace level. The volume of cookies decreased with increase in pomace as determined through the formula. The results are in agreement with the findings of Hai-Jung (2007). Sensory evaluation (Table 3) of the cookies showed that the scores for colour, taste, texture, appearance and overall acceptability are superior in 5% level of substitution than rest of the levels.

Nutritional facts of cookies :

Cookies prepared using 5%, 10%, 15%, 20% and 25 % of tomato pomace in the blend and were analyzed for different parameters. Table 4 shows that the moisture content, total fat content and protein values ranged between 3.5-3.15%, 21.70-21.80% and 5.20-3.30%, respectively. Total dietary fibre content (TDF), on the other hand, for cookie containing tomato pomace was as high as 8.20% while it was 3.10% for control cookie. Similarly soluble dietary fibre (SDF) was 3.10 and insoluble fibre 5.10. This clearly indicates that tomato pomace can be an alternative source of dietary fibre in

Table 2 : Effect of tomato pomace on the physical properties of cookies

Tomato pomace %	Diameter (mm)	Thickness (mm)	Spread factor	Volume(cc)
0%	53.25	6.90	77.1	15.35
5%	53.36	6.85	77.89	15.31
10%	53.48	6.78	78.87	15.22
15%	53.60	6.74	79.50	15.20
20%	53.70	6.68	80.30	15.12
25%	53.80	6.64	81.02	15.08

Table 3 : Effect of tomato pomace on the sensory properties of cookies

Tomato pomace %	Colour	Taste	Texture	Appearance	Over all acceptability
0%	3.78	3.12	3.10	2.80	3.00
5%	3.85	4.50	3.75	3.40	3.85
10%	3.70	4.30	3.25	3.70	3.73
15%	3.80	2.60	3.20	3.15	3.18
20%	3.82	1.50	3.10	3.14	2.90
25%	3.00	1.20	3.00	1.60	2.43

cookie making.

Total phenol content :

The total phenol content for different samples is illustrated in Table 4. The data shows that the phenol content increase with the incorporation of tomato pomcace in the cookies. The total phenolics content increased due to higher content of phenols in the tomato pomace. However, baking or drying at temperature above 60° C is regarded as unfavourable due to the possibility of inducing oxidative condensation or decomposition of thermo-liable compounds like phenolics (Asami *et al.*, 2003). The higher amount of phenolics content in the latter cake can also be due to components derived from apple pomace and the formation of intermediates such as enediols and reductoines during baking process.

Table 4 : Effect of tomato pomace on the total phenolics of cookies

Tomato pomace %	Total phenolics
0%	2.65
5%	3.15
10%	3.65
15%	4.25
20%	4.75
25%	5.35

Conclusion :

Tomato pomace like any other fibre source increases the water absorption capacity of the flour. In general tomato pomace affected the farinographic properties of the wheat flour dough. Tomato pomace having high amount of TDF can function as a valuable source of dietary fibre in cookie making. Tomato pomace also has the potential for use in cookie making as a good source of polyphenols which has antioxidant properties. Thus the cookies incorporated with tomato pomace can act as functional food due to the presence of high amounts of phenols and fibre content.

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Received : *07.06.2017*; **Revised:** *09.08.2017*; **Accepted :** *25.08.2017*