

Physico-Chemical Characteristics of Cookies Prepared with Tomato Pomace Powder

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Abstract

This study was conducted to investigate the physico-chemical characteristics of cookies added with different levels of tomato pomace powder. Cookies were prepared with six different levels of tomato pomace powder (0, 5, 10, 15, 20 and 25%) and the physicochemical properties were examined. Crude protein and ash content of cookies containing 20, 25% of tomato pomace powders were significantly higher than those of control and rest of treatments ($p < 0.05$). The spread factor of control cookie was higher than that of cookies containing 5, 10, 15, 20 and 25% of tomato pomace powder. The incorporation of tomato pomace powder in cookie lowered the lightness values but increased redness and yellowness values. Sensory evaluation revealed that overall desirability scores were not significantly different between control and tomato pomace powder incorporated cookies. The cookies up to 5% substitution of powder were found acceptable by the consumers.

Keywords: Tomato pomace powder; Cookies; Physico-chemical characteristics

Introduction

Today foods are not only intended to satisfy hunger and to provide necessary nutrients for humans but also to prevent nutrition-related diseases and improve physical and mental well-being [1]. Functional foods are quiet remedy. Cookies are widely consumed baked products which can be served from breakfast to bedtime. Cookies are appreciated for their taste, aroma, convenience, and long shelf stability due to low moisture content. Recently, increasing consumer demand for healthier foods has triggered the development of cookies made with natural ingredients exhibiting functional properties and providing specific health benefits beyond those to be gained from traditional nutrients. Tomatoes are an integral part of the human diet rich in several nutrients including vitamin A, vitamin C, potassium, calcium and lycopene. Most tomatoes produced worldwide are used as tomato juice, paste, ketchup and sauce, although a number of tomatoes are commonly consumed fresh [2]. Recent studies have indicated that a diet rich in tomatoes and tomato products is associated with a reduced risk of certain cancers [3]. The consensus seems to be that lycopene; a major carotenoid present in red tomatoes having antioxidant capacity is a natural cancer-fighting agent. It is also suggested that complex interactions among multiple nutrients present in tomatoes contribute to its anticancer properties [4].

Tomato pomace is highly perishable in its fresh state because it contains about 95% moisture and its storage is difficult [5]. Therefore, the waste is just dumped and allowed to decay which increases landfill costs and societal concerns about solid waste. These generated interest in finding an economical outlet for this byproduct. Bakery product cookies are fast and convenient food based on wheat. Cookies, which constitute an important item of bakery industry have now become a common item of consumption among all classes of people with tea or coffee. Different variety of cookies are used as one of the tasty and nutritious snacks. Cookies are more popular as a convenient food.

In present scenario, there is an increasing demand for conversion of fruit and vegetable wastes into useful products as well as to minimize environmental impact of these by-products. Successful incorporation of tomato pomace into bakery products that deliver physiologically

active components represents a major opportunity for food processors providing the consumer a healthy wheat based product to choose from which is currently lacking in the marketplace. Keeping in view the bioactive potential and health benefits of tomato pomace, the proposed study shall be undertaken to investigate the utilization of tomato pomace for development of wheat based cookies with the objective to evaluate the effects of tomato powder on the quality characteristics of cookies. Cookies were prepared with tomato powder which was substituted for 0%, 5%, 10%, 15%, 20% and 25 % of wheat flour and the physicochemical and sensory properties were investigated.

Materials and Methods

Materials

Ingredients for cookies such as wheat flour, milk, sugar, butter, egg white and baking powder were purchased from a local market. Tomato pomace prepared from local tomato variety was dried in a cabinet dryer at 60°C and then grinded in a grinder-mixer to obtain tomato pomace powder with following proximate composition: moisture 14.89%, protein 20.36%, fat 0.35%, and ash 8.97%.

Preparation of cookies

The cookie recipe used in this study is shown in Table 1. Tomato pomace powder was used to replace part of the whole wheat flour (0%, 5%, 10%, 15%, 20% and 25%) in a standard cookie recipe. Egg white, butter and sugar were creamed in a hand mixer for 3 min. Flour, tomato pomace powder and baking powder were sifted and added to the liquid ingredients and mixed for 30 seconds. The firm dough was then sheeted to a thickness of 5 mm thick with roller and cut with a cookie cutter of

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50 mm diameter. The cookies were then transferred to a lightly greased baking tray and baked in an oven at an upper heating temperature of 160°C for 15 min. The baked cookies were removed from the baking pan, cooled to room temperature for 1 hr before analysis.

Proximate composition analysis

Moisture, crude protein, crude fat and ash content were determined according to the AOAC method [6].

Physical characteristics

Cookie diameter (D) and thickness (T) of six cookies were measured as described in the AACC methods [7]. The spread factor was calculated as D/T. The volume of cookies were determined by seed displacement method

Color measurement

Surface color of cookies was determined by measuring tristimulus L (lightness), a (redness), b (yellowness) values with a colorimeter calibrated with a white standard plate (L=+98.5, a=+0.07, b=-0.40).

Sensory evaluation

Sensory evaluation was conducted after cooling the cookies for 1hr at room temperature. Cookies were placed on a plastic dish coded by a three-digit random number and offered to 8 trained panelists in an individual booth with lighting. Surface color, taste, texture, appearance and overall acceptability were evaluated using the five-point scale with 5 indicating strong attributes.

Statistical analysis

All data were recorded as means ± standard deviation of at least triplicate measurements. Means were compared with Duncan's multiple range tests with α=0.05 using SAS (Statistical Analysis System, version 8.12).

Results and Discussion

Proximate composition

The results of the proximate composition of cookies prepared with tomato powder are shown in Table 2. Moisture content of control was 2.49% and that of cookies containing tomato powder ranged from 2.24 to 3.39%. Crude protein and ash content values of the cookies containing tomato powder of 5.0, 7.5 and 10.0% were significantly higher than those of control and 2.5% added sample (p<0.05). This is attributable to the higher protein and ash content of tomato powder than wheat flour. Crude fat contents were 21.71-21.85% and no significant differences among cookies were observed.

Physical characteristics

Cookie diameter, thickness and spread factor are shown in Table 3. There were no significant differences in the diameter and thickness of the cookies between those containing up to 5.0% and the control. However, significant differences were found with higher percentages of tomato powder (p<0.05). Larger diameter and lower thickness values were observed in the formulations containing 7.5 and 10.0% of tomato powder. Thus, it could be stated that the incorporation of tomato powder in the cookies at the level of 7.5 and 10.0% affected cookie expansion by lowering gas retaining power below that of wheat flour [8]. The spread factor of cookies made with 5.0, 7.5 and 10.0% tomato powder was significantly higher than that of control (p<0.05), but a trend with the varying levels of tomato powder substitution for flour was not found. Chung and Kwon [8] reported that cookies made with yam powder exhibited a reduction in size and thickness as the content of yam powder increased. According to Kim et al. [9] barley germ increased cookie diameter and spread ratio, whereas decreased thickness and weight as the barley germ substitution level increased, and they have proposed that such increases in diameter and spread ratio may be due to the decrease in cookie dough consistency with increasing level of barley germ in the cookie formula. Dissimilar results have been

Ingredients %	Treatment combinations					
	D1T1	D1T2	D1T3	D1T4	D1T5	D1T6
Flour (g)	200	190	180	170	160	150
Tomato pomace powder (%)	0	5	10	15	20	25
Butter (g)	50	50	50	50	50	50
Milk powder (g)	50	50	50	50	50	50
Sugar (g)	100	100	100	100	100	100
Baking powder (g)	2	2	2	2	2	2
Egg white (No.s)	1	1	1	1	1	1

Table 1: Cookie recipe combinations used in the study.

	Moisture (%)	Crude protein (%)	Ash (%)	Crude fat (%)
Wheat flour	14.45 ± 0.19	9.50 ± 0.83	0.48 ± 0.01	0.87 ± 0.01
Tomato pomace powder	10.20 ± 0.75	18.25 ± 0.25	7.25 ± 0.05	0.65 ± 0.09
D1T1	2.49 ± 0.10 ^a	5.186 ± 0.25 ^a	4.883 ± 0.61 ^a	21.71 ± 0.01 ^a
D1T2	2.40 ± 0.20 ^a	5.503 ± 0.20 ^b	4.844 ± 0.22 ^a	21.80 ± 0.02 ^b
D1T3	3.39 ± 0.10 ^b	6.25 ± 0.22 ^c	4.916 ± 0.10 ^b	21.81 ± 0.55 ^b
D1T4	2.24 ± 0.01 ^c	6.406 ± 0.01 ^d	4.920 ± 0.01 ^b	21.82 ± 0.61 ^b
D1T5	2.97 ± 0.01 ^d	6.446 ± 0.01 ^d	4.912 ± 0.01 ^b	21.83 ± 0.10 ^b
D1T6	3.24 ± 0.02 ^{ab}	6.870 ± 0.01 ^{ab}	4.927 ± 0.02 ^b	21.85 ± 0.01 ^c

Each value is mean ± standard deviation (SD).

Means with different letters within a column are significantly different from each other at α=0.05 as determined by Duncan's multiple range tests.

Table 2: Proximate compositions of cookies prepared with tomato powder.

Groups	D1T1	D1T2	D1T3	D1T4	D1T5	D1T6
Diameter(cm)	19.26 ± 0.10 ^a	19.30 ± 0.10 ^b	19.33 ± 0.05 ^c	19.75 ± 0.02 ^d	19.92 ± 0.25 ^{ab}	19.96 ± 0.10 ^{bc}
Thickness (cm)	3.10 ± 0.10 ^a	2.85 ± 0.08 ^b	2.82 ± 0.12 ^c	2.75 ± 0.25 ^d	2.64 ± 0.54 ^{ab}	2.55 ± 0.09 ^{bc}
Spread factor	6.21 ± 0.06 ^a	6.77 ± 0.12 ^b	6.85 ± 0.25 ^c	7.18 ± 0.12 ^d	7.54 ± 0.25 ^{ab}	7.82 ± 0.01 ^{ac}

Each value is mean ± SD.

Means with different letters within a row are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range test.

Table 3: Diameter, thickness and spread factor of cookies prepared with tomato powder.

Group	L	a	b
D1T1	52.33 ± 0.88 ^a	3.31 ± 0.16 ^a	30.47 ± 1.16 ^a
D1T2	50.35 ± 0.22 ^b	5.68 ± 0.01 ^b	37.63 ± 0.10 ^b
D1T3	48.22 ± 0.30 ^c	6.74 ± 0.25 ^c	36.66 ± 2.45 ^c
D1T4	48.20 ± 2.88 ^c	7.49 ± 0.29 ^d	37.85 ± 0.36 ^b
D1T5	47.55 ± 0.55 ^d	8.33 ± 0.90 ^{ab}	41.59 ± 0.12 ^d
D1T6	47.45 ± 0.10 ^d	8.56 ± 0.01 ^{ab}	41.66 ± 0.01 ^d

Each value is mean ± SD.

Means with different letters within a column are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range tests.

Table 4: Colorimetric characteristics of cookies prepared with tomato powder.

Group	Taste	Texture	Color	Appearance	Overall acceptability
D1T1	4.22 ± 0.85 ^a	3.55 ± 0.80 ^a	3.44 ± 0.10 ^a	3.62 ± 0.01 ^a	3.70 ± 0.01 ^a
D1T2	4.25 ± 0.02 ^a	3.85 ± 0.25 ^b	4.56 ± 1.41 ^b	4.50 ± 1.60 ^b	4.29 ± 1.24 ^b
D1T3	3.24 ± 1.21 ^b	3.65 ± 0.68 ^b	3.28 ± 0.98 ^a	3.68 ± 0.27 ^a	3.46 ± 0.32 ^a
D1T4	3.29 ± 0.58 ^b	3.22 ± 0.01 ^a	3.3 ± 0.10 ^a	3.25 ± 0.01 ^a	3.26 ± 0.10 ^a
D1T5	3.88 ± 0.25 ^c	3.26 ± 0.05 ^a	3.35 ± 0.02 ^a	2.66 ± 0.01 ^c	3.28 ± 0.05 ^a
D1T6	3.10 ± 1.25 ^b	3.45 ± 2.15 ^a	2.25 ± 0.05 ^c	2.22 ± 0.01 ^c	2.75 ± 0.01 ^c

Each value is mean ± SD.

Means with different letters within a column are significantly different from each other at $\alpha=0.05$ as determined by Duncan's multiple range tests.

Table 5: Sensory scores of cookies prepared with tomato powder.

observed by other researchers, who reported that the spread ratio of cookies prepared with bamboo leaf powder decreased with increasing amount of bamboo leaves powder [10]. Cho et al. [11] also reported that the addition of sea tangle powder lowered the spread ratio of cookies. From these results, it is suggested that the incorporation of different ingredients into cookie products result in different physical properties. In general, cookie spread or diameter is used as an indicator of cookie quality and cookies with larger spread or diameter are considered more desirable [12].

Color measurement

The results of Hunter Lab color value of cookies are shown in Table 4. The L value (lightness) of control cookies was 52.33 and those of tomato powder cookies ranged from 50.35 to 47.45, indicating that lightness decreased with the reduction in the proportion of wheat flour because of the loss of white color of the flour ($p < 0.05$). Therefore, it could be expected that cookies would become darker with increasing amount of tomato powder level. The 'a' value (redness) of control cookies was 3.31 and those of tomato powder groups were 5.68-8.56, showing more reddish color than control. This is attributable to the reddish color of tomato powder. The b value (yellowness) of control group was 30.47 and cookies substituted with different levels of tomato powder ranged from 37.63 to 41.66, having more yellowish color than control. Similar results were obtained by Kim et al. [9] who reported that the color of sugar- snap cookies became darker, more red and yellow with increasing amounts of barley germ. Singh et al. [13] reported that lightness value decreased while redness and yellowness values increased as the substitution.

Sensory evaluation

Results of sensory evaluation of cookies with added tomato powder are shown in Table 5. The color was evaluated to become darker as the tomato powder level increased, which is due to the reddish color of tomato powder. This is in agreement with the result of lightness values shown in Table 4. Scores of tomato taste were higher in cookies added with tomato powder than those of control cookies because tomato powder gave a characteristic taste. The hardness score was higher in 5% substitution than those of cookies substituted with different levels of tomato powder. The appearance score was found higher in 5% substitution level than rest of the treatments. Appearance score was judged on the basis of number of cracks on the surface of cookies. The higher the cracks with uniformity better will be the cookie. There were no significant differences in the overall desirability scores between control cookies and tomato powder added cookies. Therefore, replacing up to 5% wheat flour with tomato powder would not result in significant differences in the acceptability of cookies.

Conclusion

In the experiment it was concluded that the cookies incorporated with the tomato pomace powder were found acceptable up to 5% substitution. The color of the cookies becomes more and darker as the level of pomace powder increased. Spread factor of the cookies was increased due to the pomace incorporation.

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