Use of wheat flour and spent coffee grounds in the production of cookies with high fiber and antioxidant content: Effects of spent coffee grounds ratio on the product quality

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Abstract. Spent coffee ground (SCG) is the main by-product of the instant coffee industry. In this study, wheat flour and dried SCG powder were used in the production of cookies with high fiber and antioxidant content. The objective of the study was to evaluate the effects of SCG ratio in the cookie formulation on nutritional quality, physical properties and sensory overall acceptability of the product. SCG is a rich source of dietary fiber. In 100 g dry weight of SCG, the total fiber and phenolic contents were 76.6 ± 0.58% and 3828±12 mg GAE/ 100g dry basis, respectively. When the SCG ratio increased from 0 to 0.25 of the composite flour weight, the dough had increased hardness and reduced adhesiveness, cohesiveness and springiness. An increase in the SCG ratio in the cookie formulation also decreased the diameter and thickness of the product but enhanced its hardness. Cookie samples supplemented with SCG had higher dietary fiber and phenolic content as well as a higher antioxidant activity than the control sample. Cookie samples were considered as high fiber food when the SCG ratio was 0.1 or higher. The use of SCG reduced the overall acceptability of cookies. When the ratio of SGC powder varied from 0.1 to 0.2, a sensory score of the obtained cookies was acceptable.

1 Introduction
Cookies have been one of the most popular food products on the market due to their affordable price, convenience, high nutritional value, diversity of flavors and long shelf-life. Cookies contain a lot of sugar, starch and lipid but their amount of dietary fiber, vitamins and minerals are low [1]. Nowadays, producers have focused on developing many types of cookies; among them, high dietary fiber and antioxidant cookies have attracted great attention. High fiber foods may prevent cardiovascular diseases, obesity, diabetes, and several types of cancers. Dietary fibers can be divided into 2 subgroups: soluble (oligosaccharide, pectin, β-glucan) and insoluble (cellulose, hemicellulose and lignin) [1]. High...
antioxidant foods can prevent or slow damage to cells caused by free radicals. Among the natural antioxidants, phenolics are a well-known group of plant materials [2].

Coffee is long known as one of the most popular and most consumed beverages in the world. In instant coffee production, for every kilogram of instant coffee powder produced, 2 kg of wet SCG is released as a by-product [3]. This by-product has been used in the extraction of phenolic compounds and dietary fibers as well as in the production of bioethanol, animal feed, biofertilizer, biological absorbents, enzyme preparations [4-6]. It should be noted that SCG also contains different nutrients including protein, lipid and minerals [7] and it could be used as an ingredient for food processing. Recently, SCG was added to bakery products in Spain and Mexico [8, 9].

In Vietnam, coffee production has been a major source of agricultural income and Coffee robusta is a predominant variety. The released by-product SCG are mostly used as fertilizer, while their use in food processing has not been considered. In this research, SCG of Coffee robusta was added to the cookie recipe to improve the dietary fiber and antioxidant content of the product. The objective of the study was to investigate the effects of SCG ratio in the cookie formulation on product quality.

2 Materials and methods

2.1 Materials

SCG from Robusta coffee variety was provided by Neuman group GMBH (23 Vo Truong Toan, Thao Dien Ward, District 2, HCM city). To ensure the homogeneity and stability of the materials, SCG was dried at 60°C for 8 h to reach 6-0.1 moisture content. The dried SCG was then ground and sieved through a 40-mesh screen. The sieved SCG were divided into small polyethylene bags and vacuum-sealed to remove air; those bags were stored at 4°C for experimentation.

The ingredients for cookie baking included wheat flour with 8% gluten from Dai Phong Flour Co.Ltd; fresh eggs from Ba Huan Co. Ltd (66-70.05 moisture, 9-0.15 protein); isomalt diet sugar of Vikybomi company (98% carbohydrates); unsalted butter from Pilot, Australia (84% lipid); acesulfame potassium from Vitasweet, China (98.87% purity); refined salt from Southern Vietnamese salt Corp. (98% NaCl); vanilla flavour from Rayner’s (England) and baking powder from Alsa (France). Chemicals used for quantitative analysis were from Sigma-Aldrich company (USA); enzyme preparations (Termamy SC, Alcalase 2.5L) used for fiber quantification were provided by Brenntag Vietnam Co.Ltd.

2.2 Experimentation

Wheat flour and SGC were used as the main ingredients for cookie making. The ratio of SCG to flour weight was 0 (control sample), 0.05, 0.10, 0.15, 0.20 and 0.25. Other ingredients (calculated for 1 kg composite flour) included 305 g of fresh chicken eggs, 467 g unsalted butter, 310 g isomalt, 4.4 g refined salt, 10.6g baking powder, 4 g of vanilla and 87 mL water [7].

Procedures for cookie making: Egg whipping (both egg yolk and white) was done in the mixer (Model M8, UNIE) for 4 min and the speed was 200 rpm; acesulfame potassium, isomalt, NaCl, vanilla flavour and baking powder were then added to the egg mixture and mixed for a further 4 min; the butter was next added and continually mixed for 5 min. Finally, the wheat flour-SCG powder mixture was added and mixed for 2 min at 100 rpm. The dough was flattened to 4 mm in thickness and cut into 35 mm in diameter using a cookie cutter.

The cookies were baked within 2 stages: the first stage was performed at 175°C for 14 min, while the second stage was done at 150°C for 4 min. After baking, the cookies were cooled down to room temperature and put into polyethylene bags, vacuum-sealed to remove air.
2.3 Analytical methods

2.3.1 Proximate composition
Proximate composition of wheat flour, SCG and cookies was determined using AOAC methods [10]. The moisture content was quantified by drying to constant weight using AOAC 930.15 method. Lipid was measured by Soxhlet system using AOAC 960.39 method; protein was analyzed by Kjeldahl – Nessler procedure using AOAC 984.13 method. Ash was determined by AOAC 930.30 method. The soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) content were measured following AOAC 993.19 and AOAC 991.42 methods, respectively. The total dietary fiber (TDF) content was the sum of SDF and IDF. The starch content was analyzed according to the enzymic/colorimetric method [11]. The amount of carbohydrate was calculated by subtracting the percentage of moisture, protein, lipid and ash content.

2.3.2 Antioxidant content and activity
Total phenolic content was measured by spectrophotometric method using Folin-Ciocalteau reagent; the results were expressed in mg Gallic Acid Equivalent per 100 g dry basis (mg GAE/100g dry basis) [11]. Antioxidant activity was evaluated by spectrophotometric method using 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. The results were expressed in micromole Trolox equivalent per 100 g dry basis (μM TE/100 g dry basis) [11].

2.3.3 Physical properties of spent coffee grounds powder, wheat flour, dough and cookies
Water and oil holding capacity of wheat flour and SCG was analyzed by a method described by Jia, et al. (2020) [12]. Physical properties of dough including hardness, adhesiveness, cohesiveness and springiness were measured using a texture profile analyzer (Model 5543, Instron, USA) and the procedures followed Yildiz, et al. (2013) [13]. Diameter and thickness of cookies were determined using a method described by Mishra (2012) [14]. Hardness of cookies was determined using a texture profile analyzer (Model 5543, Instron, USA) and 3 points measuring method reported by Aziah (2012) [15]. Instrumental colors were measured using CIELAB system, the results were expressed by L* (brightness), a* (from green to red) and b* (from green to yellow). The total color difference (ΔE) between the SCG added cookies and the control cookie was calculated by a formula previously described elsewhere [16].

2.3.4 Overall acceptability of cookies
Overall acceptability of cookies was measured using the method of Mudgil et al (2019) [17], with a maximum score point of 9 based on preference, from like to dislike. The participants were up to 60 people.

2.4 Statistical analysis
All experiments were triplicated. The results of this study were expressed as mean ± standard deviation. One-way analysis of variance and Tukey’s comparison test with significance level at p < 0.05 were carried out on Minitab 16.

3 Results and discussion

3.1 Comparison of proximate composition, antioxidant activity and physical properties of spent coffee grounds powder and wheat flour
The proximate composition, antioxidant activity and physical properties of wheat flour and SCG were presented in Table 1. The protein content of SCG was similar to that of wheat flour. On the contrary, the content of lipid, ash, total, insoluble and soluble fiber as well as the ratio of insoluble to the soluble fiber...
The total carbohydrate content of SCG was lower than that of wheat flour. It should be noted that the main carbohydrate in SCG was insoluble dietary fiber while starch was a predominant carbohydrate of wheat flour.

The lipid content of SCG of this study was 4.7 and 2.7 times lower than that of Martinez-Saez et al. (2016) [7] and that of Hussein et al. (2019) [18], respectively. However, it was 2.3 times higher than that of the research of Ballesteros et al. (2014) [19]. On the other hand, the total dietary fiber content of SCG of our study was 1.6 times higher than that of Martinez-Saez et al. (2016) [7]. The difference in proximate composition of SCG is due to various varieties of the material, planting conditions and extraction conditions.

The total phenolic content of SCG was 23.5 times higher than that of wheat flour. In addition, the antioxidant activity of SCG evaluated by DPPH and FRAP assays were 456.1, and 214.2 times, respectively, higher than that of wheat flour. It is expected that the use of SCG in cookie making may enhance antioxidant activity of the product.

| Table 1. Chemical composition and physical properties of wheat flour and spent coffee grounds powder |
|----------------------------------|----------------------------------|
| Moisture content (% wet basis)   | 8.6±0.1a                        |
| Protein (% dry basis)            | 10.1±0a                         |
| Lipid (% dry basis)              | 5.2±0.31b                       |
| Ash content (% dry basis)        | 1.7±0.04b                       |
| Insoluble fibre (% dry basis)    | 72.1±0.56b                      |
| Soluble fiber (% dry basis)      | 4.4±0.04b                       |
| Total dietary fiber (% dry basis)| 76.6±0.58b                      |
| Starch (% dry basis)             | Nd                              |
| Total carbohydrate (% dry basis) | 83±0.3a                         |
| Total phenolic content (mg GAE/100 g dry basis) | 3828±12b |
| Antioxidant activity DPPH (µM TE/100g dry basis) | 37979±56b |
| Antioxidant activity FRAP (µM TE/100g dry basis) | 27851±37b |
| Water absorption ability (g water/g dry basis) | 2.73±0.13b |
| Oil absorption ability (g oil/g dry basis) | 1.61±0.03b |
| L*                               | 20.1±0.0a                       |
| a*                               | 2.2±0.1b                        |
| b*                               | 2.7±0.0a                        |

Nd: not determined; Values with different letters within the same row are statistically different (p < 0.05).

Water and oil holding capacities of SCG were 3.7 and 1.7 times, respectively, higher than those of wheat flour and that was due to the high fiber content of SCG. The ability of a material to absorb water is expressed through the amount of water that the material retains under the action of centrifugal force or compression, including bound water, free water and retained water due to the network structure of the material. The water absorption capacity of a material depends on the polysaccharide composition and properties, porosity and particle size [20]. The oil absorption capacity of a material is influenced by various factors including the structure of polysaccharide compounds, surface characteristics, density, thickness and hydrophobicity of fiber. The oil absorption capacity of the material is directly proportional to the IDF content [21].

L* and b* values of SGC were lower than those of wheat flour, indicating that coffee grounds were darker and had less yellow color than wheat flour. Conversely, a* value of SGC was larger than that of SCG was significantly higher than those of wheat flour.
wheat flour, indicating that the red color of SCG was more intensive than that of wheat flour. These results are similar to those reported by Hussein et al. (2019) [18].

3.2 Effects of spent coffee grounds powder ratio in the cookie formulation on proximate composition and antioxidant activity of the product

Changes in proximate composition and antioxidant activity of cookies at different ratios of SCG in the recipe are detailed in Table 2. The moisture content of all cookie samples was varied in a narrow range and it met the required standard of the bakery industry [22]. When increasing the ratio of SCG from 0 to 0.25, the protein content of the product was not significantly different. It can be explained that the protein content of SCG and wheat flour was statistically similar. Nevertheless, an increase in SCG ratio from 0 to 0.25 slightly enhanced the lipid and ash content of cookies, since SCG was much richer in lipid and ash than wheat flour. On the contrary, the starch content of cookies gradually decreased when the SCG ratio increased since starch was not detected in SCG. The total carbohydrate content of the product was also decreased with increasing the SCG ratio in the cookie formulation due to the lower carbohydrate content of SCG.

Table 2. Proximate composition and antioxidant activity of cookies at different ratios of spent coffee grounds in the product formulation

| Ratio of spent coffee grounds to flour weight | 0    | 0.05 | 0.10 | 0.15 | 0.20 | 0.25 |
|---------------------------------------------|------|------|------|------|------|------|
| Moisture content (% dry basis)              | 3.1±0.1<sup>a</sup> | 3.1±0.1<sup>a</sup> | 3.1±0<sup>b</sup> | 3.3±0<sup>b</sup> | 3.4±0<sup>c</sup> | 3.4±0.1<sup>bc</sup> |
| Protein (% dry basis)                       | 6.8±0.3<sup>a</sup> | 6.7±0.3<sup>a</sup> | 6.7±0.3<sup>a</sup> | 6.7±0.2<sup>a</sup> | 6.6±0.1<sup>a</sup> | 6.7±0.1<sup>a</sup> |
| Lipid (% dry basis)                         | 23.6±0<sup>b</sup> | 24.7±0.1<sup>c</sup> | 25.1±0<sup>c</sup> | 25.4±0.1<sup>d</sup> | 25.7±0<sup>e</sup> | 25.9±0.1<sup>f</sup> |
| Carbohydrate (% dry basis)                  | 68.7±0.4<sup>c</sup> | 67.5±0.4<sup>d</sup> | 67.1±0.3<sup>c</sup> | 66.8±0.2<sup>b</sup> | 66.5±0.1<sup>b</sup> | 66.2±0.1<sup>c</sup> |
| Starch (% dry basis)                        | 58.4±0.1<sup>f</sup> | 52.3±0.4<sup>c</sup> | 50.8±0.1<sup>d</sup> | 47.7±0.8<sup>c</sup> | 45.5±0.3<sup>b</sup> | 43.9±0.6<sup>c</sup> |
| TDF (% dry basis)                           | 1.7±0.1<sup>b</sup> | 4±0.2<sup>b</sup> | 5.5±0.1<sup>c</sup> | 7.3±0<sup>d</sup> | 9.1±0<sup>e</sup> | 10.7±0.1<sup>f</sup> |
| SDF (% dry basis)                           | 0.8±0<sup>a</sup> | 1.1±0.1<sup>b</sup> | 1.1±0<sup>b</sup> | 1.3±0.1<sup>c</sup> | 1.4±0.1<sup>d</sup> | 1.6±0.1<sup>e</sup> |
| IDF (% dry basis)                           | 2.5±0.1<sup>a</sup> | 5.1±0.2<sup>b</sup> | 6.6±0.1<sup>c</sup> | 8.6±0<sup>d</sup> | 10.5±0.1<sup>c</sup> | 12.3±0.1<sup>f</sup> |
| Ash content (%)                             | 0.95±0.03<sup>a</sup> | 1.05±0.05<sup>b</sup> | 1.10±0.02<sup>c</sup> | 1.14±0.01<sup>d</sup> | 1.19±0.01<sup>e</sup> | 1.24±0.01<sup>f</sup> |
| TPC (mgGAE/100g dry basis)                  | 204±2<sup>a</sup> | 357±4<sup>b</sup> | 374±6<sup>c</sup> | 474±2<sup>d</sup> | 540±4<sup>e</sup> | 678±11<sup>f</sup> |
| DPPH (µmolTE/100g dry basis)                | 140±4<sup>a</sup> | 1015±42<sup>b</sup> | 1757±85<sup>c</sup> | 2983±10<sup>d</sup> | 3330±83<sup>c</sup> | 3813±89<sup>f</sup> |
| FRAP (µmolTE/100g dry basis)                | 517±3<sup>a</sup> | 1854±15<sup>b</sup> | 2009±29<sup>c</sup> | 3337±29<sup>d</sup> | 3736±58<sup>c</sup> | 4568±50<sup>f</sup> |

Values with different letters within the same row are statistically different (p < 0.05).

The use of SCG in the cookie recipe highly improved the dietary fiber content of the product. At the ratio of 0.25 SCG, the total, soluble fiber, insoluble fiber content of the product increased by 4.6, 2.0 and 6.2 times, respectively, as compared to that of the control sample. According to the nutritional labelling guidelines of Codex Alimentarius, food with total dietary fiber content higher than 6% can be considered as high fiber food [23]. The results of Table 2 reveal that cookies with 0.10-0.25 SCG powder are high fiber food.
These results were similar to those obtained by Aguilar-Raymundo et al. (2019) when coffee silver skin was used as a fat replacer in the cake formulation. These authors revealed that a change in coffee silver skin ratio from 0.10 to 0.25 did not change the protein content of the cake; however, the ash content steadily increased from 1.1 to 1.4% while the total carbohydrate content decreased from 78.9 to 76.0% [9]. When increasing the SCG ratio in the cookie recipe from 0 to 0.25, the total phenolic content, antioxidant capacity of the product evaluated by DPPH and FRAP assays increased by 3.3, 27.3, and 8.8 times respectively. According to Mussatto et al. (2011), chlorogenic acid is the most important phenolic compound of SCG that has high antioxidant activity [24].

3.3 Effects of spent coffee grounds powder ratio in the cookie formulation on physical properties of cookie dough

Cookie dough is an important intermediate product in cookie processing. Physical properties of cookie dough with various SCG powder ratios are demonstrated in Table 3. The higher the ratio of SCG in the cookie formulation, the higher the hardness of cookie dough. However, an increase in SCG ratio slightly reduced the adhesiveness, cohesiveness and springiness of the dough. At the SCG ratio of 0.25, the hardness increased by 1.37 times while the adhesiveness, cohesiveness and springiness declined by 35.4%, 35.9%, and 28.7%, respectively as compared to those of the control dough. This observation is similar to the result of Altes et al. (2018 and 2019) when coffee silver skin was added to biscuit formulation [25, 26]. The texture of cookie dough is affected by the content and properties of protein and fibers. Although SCG powder and wheat flour have the same total protein content, their protein composition is different, resulting in different properties of the obtained dough samples. Gluten of wheat flour is responsible for the springiness of cookie dough, while proteins of SCG do not have this ability [27, 28]. As a result, addition of SCG to the cookie recipe reduced springiness of the obtained dough.

| Table 3. Physical properties of cookie dough with different spent coffee grounds ratios |
|----------------------------------------|---------|---------|---------|---------|---------|---------|
| | 0 | 0.05 | 0.10 | 0.15 | 0.20 | 0.25 |
| Hardness (g) | 371±3ª | 390±3ª | 408±2ª | 441±2ª | 473±6ª | 508±12ª |
| Adhesiveness (g.s) | 263±6ª | 234±22ª | 206±37ª | 196±41ª | 187±46ª | 70±22ª |
| Cohesiveness | 0.46±0.01ª | 0.42±0.02ª | 0.37±0.03ª | 0.35±0.03ª | 0.33±0.03ª | 0.30±0.01ª |
| Springiness (mm) | 0.74±0.01ª | 0.67±0.01ª | 0.61±0.01ª | 0.59±0.03ª | 0.57±0.04ª | 0.53±0.01ª |

Values with different letters within the same row are statistically different (p < 0.05).

According to Martinez et al. (2014), the soluble fiber in the dough may reduce its hardness and consistency while insoluble fiber may increase its hardness [29]. In addition, soluble fiber can bind to hydrocolloids in the aqueous phase of dough, forming a film that encloses flour and starch granules, providing stability to the dough structure. On the contrary, insoluble fiber can disrupt dough network structure. It is reported that the lower the free water content, the higher the hardness of the dough [30]. When increasing the SCG ratio in the formulation, water absorption capacity of the dough increased since the content of insoluble fiber of SCG was 3.8 times higher than that of wheat flour. This phenomenon reduced the amount of free water in the dough. As a result, the dough became dryer and harder.

3.4 Effects of spent coffee grounds powder ratio in the cookie formulation on physical properties of biscuit

Physical properties of cookies are presented in Table 4. The use of SCG slightly decreased both the diameter and thickness of cookies. At 0.25 SCG, the diameter and thickness of cookies decreased by 1.0.05 and 4.6%, respectively, in comparison with those of the control. Similar results were also reported...
by Sudha et al. (2019) when wheat bran, rice bran, oat bran or barley bran was alternatively added to the cookie formulation [31]. It can be noted that the change in the spread factor of cookies was little; this value varied within a narrow range (5.4 – 5.6). However, the cookies supplemented with SCG had increased hardness in comparison with the control sample. Indeed, the physical properties of cookies are directly related to the textural properties of cookie dough. The harder the dough, the higher the cookie hardness and the lower the diameter and thickness of the product [32].

Table 4 Physical properties of cookies with different spent coffee grounds powder ratios

| Ratio of spent coffee grounds to flour weight | 0         | 0.05      | 0.10      | 0.15      | 0.20      | 0.25      |
|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Diameter (mm)                               | 35.2±0.2c | 35.1±0.1c | 34.9±0.1b | 34.9±0.1b | 34.8±0.0a | 34.7±0.1a |
| Thickness (mm)                              | 6.5±0c    | 6.44±0.04c| 6.3±0b    | 6.27±0.02b| 6.2±0a    | 6.2±0.01a |
| Spread factor (SF)                           | 5.4±0.1a  | 5.5±0b    | 5.5±0e    | 5.6±0c    | 5.6±0e    | 5.6±0e    |
| Hardness (N)                                | 628±15a   | 775±21b   | 841±26c   | 882±11d   | 921±7e    | 952±10f   |
| L*                                          | 52.5±0.2e | 43.5±0.2f | 40±0.1c   | 38.5±0.2d | 35.7±0.3c | 35.9±0.1c |
| a*                                          | 8.0±0.1b  | 3.5±0.1e  | 2.9±0.1f  | 2.3±0.1e  | 1.6±0.1d  | 1.1±0.1c  |
| b*                                          | 29.8±0.1b | 16.6±0.1s | 13.3±0.1f | 11.3±0.1e | 9.2±0.1d  | 11.3±0.1e |
| ΔE                                          | 0±0e      | 16.8±0.1b | 21.5±0e   | 24.0±0.2d | 27.6±0.2e | 26±0.1f   |

Values with different letters within the same row are statistically different (p < 0.05).

When the ratio of SCG powder in the biscuit recipe increased from 0 to 0.25, the L*, a* and b* values gradually decreased. At 0.25 SCG, the cookie brightness was only 68% compared to that of the control. Moreover, the cookies tend to reduce red and yellow color. As a result, an increased ΔE value was observed at a high ratio of SCG powder. It can be explained that all L*, a* and b* values of SCG were much lower than those of wheat flour. Similar results were reported by Hussein et al. (2019) when wheat flour was partially replaced by SCG powder in a sponge cake recipe. According to these authors, L*, a* and b* values of the sponge cake with 6% SCG were reduced by 11.6%, 43.7% and 5.7% respectively, compared to those of the control sample [18].

3.5 Effects of spent coffee grounds powder ratio in the cookie formulation on sensory properties of cookies

The overall acceptability of all cookie samples is shown in Table 5. The sensory score of the cookie samples supplemented with SCG powder was similar to or lower than that of the control sample. Reduction in sensory quality was previously reported by Aguilar-Raymundo et al. (2019) when coffee silver skin was added to the cake recipe [9]. It can be noted that an increase in SCG ratio from 0.05 to 0.2 did not change in overall acceptability of the SCG added cookies. However, further increase in SCG ratio from 0.10 to 0.25 decreased the sensory score of the product, probably due to highly increased hardness. Moreover, when the SCG ratio varied from 0.1 to 0.2, a sensory score of the obtained high Fiber cookie samples was acceptable.

Table 5. Overall acceptability of cookie samples with various ratios of spent coffee grounds powder

| Ratio of spent coffee grounds to flour weight | 0         | 0.05      | 0.10      | 0.15      | 0.20      | 0.25      |
|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Overall acceptability                       | 6.03±1.55d| 5.3±1.98c | 5.05±1.78bc| 5.4±1.65cd| 5.42±1.51cd| 4.55±1.83vb|
Values with different letters within the same row are statistically different (p < 0.05).

4 Conclusion
SCG powder was a rich source of fiber and phenolic compounds with high antioxidant activity. The addition of SCG to the cookie formulation enhanced the dough’s hardness but decreased its adhesiveness, cohesiveness and springiness. An increase in SCG powder from 0 to 0.25 of the composite flour weight significantly improved the dietary fiber and phenolic content of the product as well as augmented its antioxidant activity. In addition, the use of SCG decreased the diameter and thickness of the product. Cookie samples with SCG had increased hardness in comparison with the control sample. When the SCG ratio varied from 0.1 to 0.2, the obtained cookies were considered as high fiber food and their sensory quality was acceptable. SCG powder is a potential source of fiber and antioxidant for the bakery industry.

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