

Physical Properties and Sensory Acceptability of Spent Coffee Ground as a Food Ingredient in Edible Cups

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Abstract: This study aims to develop the optimal formula for spent coffee ground edible cups. The results indicated that the second formula which consist of wheat flour 55.42%, butter 16.90%, ground brown sugar 14.91 %, eggs (white and yolk) 11.92%, salt 0.60% and spent coffee ground 0.25% is the optimal ratio. The average size of the produced spent coffee ground edible cup was present are the as 67.42 ± 1.69 , 65.11 ± 2.46 , 66.72 ± 0.72 and 57.27 ± 3.27 mm. of outside height, internal height, outside diameter and internal diameter of the cup, respectively. The color parameter L^* , a^* and b^* represented as 37.67 ± 1.08 , 7.20 ± 0.37 and 27.63 ± 0.63 . The water activities value of products is about 0.78. The sensory evaluation was used 9 points hedonic scales by 30 examiners. The sensory score of formula 2 was demonstrated that shape, color, aroma, flavor, texture, and overall acceptability were 7.00 ± 1.41 , 6.53 ± 0.94 , 6.20 ± 1.38 , 6.63 ± 1.13 , 6.40 ± 1.25 and 7.03 ± 1.13 , respectively.

1 INTRODUCTION

Coffee is the most importance of food commodity. The coffee brew and coffee beverage are important in the economic, which are prepared from roasted coffee bean and ground coffee. There are several health functional components in the coffee brew for example, caffeine, chlorogenic acid and caffeic acid. They might cause an environmental problem (Patricia and Victor, 2012). There are about 6 million ton of spent coffee ground from the coffee industry annually (Solange *et al.*, 2011, Nuria *et al.*, 2017 and Lina *et al.*, 2014). Several studies of using spent coffee ground such as apply in cosmetic, fertilizer and pesticide, etc. However, spent coffee ground are a source of health benefit compounds (Rocio *et al* 2015).

This day, the edible packaging is useful to conventional packaging to reduce waste and to create a novel application. The aim of this study was to use of spent coffee ground as the food ingredient in innovative cups, while contributing an acceptance product quality.

2 MATERIALS AND METHODS

2.1 Spent Coffee Grounds Preparation

Spent coffee ground (SCG) were obtained from the Rabbit coffee cafe, Nan, Thailand. The raw material with 80% humidity approximately was dried at $70 \pm 2^\circ\text{C}$ until constant weight (about 5% moisture content). The dried SCG was stored for edible cups processing and product quality testing.

2.2 Edible Cups Processing

The weight of ingredient of each formula were shown in Table1. Initially, flour and SCG were sifted to separate the impurity and make them to a smaller particle. Salt was added into the melt butter and stirred at room temperature until homogenous. After that, the ground brown sugar was mixed with eggs at room temperature until uniformly. Then, melt butter with salt was added into the liquid mixture (the mixture of butter, brown sugar, egg and salt). Flour was divided into three parts. Subsequently, each part was added little by little and mixed until homogenous.

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Finally, the mixtures of the SCG edible cup were baked at 120-130 °C for 1 hour and 45 min in the bakery oven.

2.3 Edible Cup Formulations

The formulas of SCG edible cup were illustrated in Table 1. The SCG edible cups were prepared using as basic ingredients wheat flour, butter, brown sugar. SCG was supplemented as coloring and flavor agents. The amount of SCG added to edible cups between 0-15% in order to achieve the most consumer acceptance.

2.4 Physical Analysis

2.4.1 Size Measuring

Size of edible cups was measure for consistency processing. The size was quantified by outer height, inner height, outer diameter and inner diameter. Size data are represented in the figure 1.

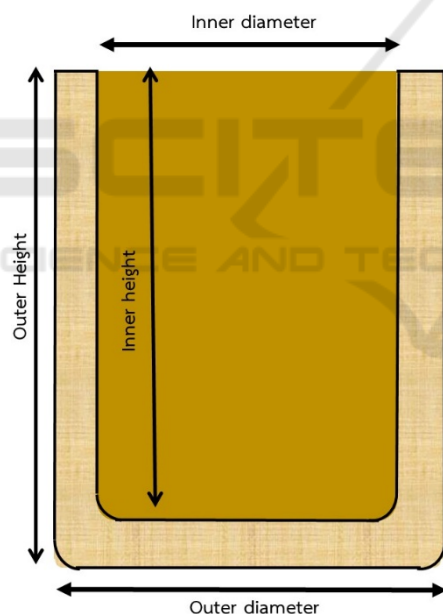


Figure 1: Cross section of the SCG edible cup.

2.4.2 Color Analysis

The color of SCG edible cups was determined by CIE color scale L*, a* and b* using a Lab digital colorimeter (Model CR-10, Minolta, Japan). Color values were recorded as L*= Lightness (0=black, 100= white); a* (-a*= greenness, +a*=redness); b* (-b*= blueness, +b*=yellowness).

2.4.3 Water Activity (a_w) Analysis

It was measured in a water activity system at 25°C. The calibration was carried out as indicated by the manufacturer. Water activity (a_w) was as certain by the chilled mirror technique using an Aqua lab (C3 TE, USA).

2.4.4 Sensory Evaluation

Sensory evaluation of SCG edible cups (SEC1, SEC2, SEC3, SEC4 and SEC5) was carried out applying a hedonic sensory test. Sensory evaluation was performed in the same session involving in total 30 untrained panelists. Shape, color, aroma, flavor, texture and overall acceptance of the selected SCG edible cup were observed. The results of rhetorical scale test were converted into a 9-point scale scoring 1 (lowest) – 9 (highest) and the average of the panelists' score was calculated.

2.4.5 Statistical Analysis

The data were expressed as the mean value \pm standard deviation (SD). Analysis of variance (ANOVA) and Duncan's post hoc test was applied to establish differences between means. The differences were examined to be significant at $p < 0.05$. IBM SPSS version 17.0 was used for data processing. The physical properties data was using a completely randomized design (CRD).

Table 1: SCG edible cups formulations.

Ingredients (g)	Treatments				
	SEC1	SEC2	SEC3	SEC4	SEC5
Wheat flour	55.67	55.42	55.17	54.42	54.17
Butter	16.90	16.90	16.90	16.90	16.90
Brown sugar	14.91	14.91	14.91	14.91	14.91
Egg	11.92	11.92	11.92	11.92	11.92
Salt	0.60	0.60	0.60	0.60	0.60
SCG	0	0.25	0.5	1.25	1.50
Total	100	100	100	100	100

3 RESULTS AND DISCUSSION

3.1 The SCG Edible Cups Size

The size of the cups is represented in table 2. All the formulas, size was consistency. As a result, the outer height was in range 67.29 to 69 mm. The inner height was present from 62.37 to 65.11 mm. Moreover, the outer diameter and the inner diameter were in between 66.40 to 68.13 mm. and 57.27 to 58.94 respectively.

3.2 The Color of SCG Edible Cups

Physiochemical properties are illustrated in table 3. The lightness (L^*) lowest is formula 4 and 5, which evidence the more darkness of these products. However, the (a^*) values were in between 2.69 to 8.53 in formula 5 and 1 respectively. These represent more SCG therefore, redder products. The (b^*) values were low in formula 4 and 5 as 21.79 and 21.83 respectively, which represent more yellowish in the more SCG in products.

Table 2: Size of SCG edible cups (mm.)

	Treatments				
	SEC1	SEC2	SEC3	SEC4	SEC5
Outer height	67.29	67.42	69.33	68.89	69.00
	±	±	±	±	±
	1.51	1.69	1.22	1.29	1.46
Inner height	62.85	62.37	65.11	64.75	62.71
	±	±	±	±	±
	2.49	2.62	2.46	1.53	3.24
Outer diameter	66.71	66.72	66.40	66.49	68.13
	±	±	±	±	±
	1.63	0.72	1.43	0.48	1.74
Inner diameter	58.94	57.27	57.38	57.45	58.34
	±	±	±	±	±
	2.12	3.27	0.63	0.76	2.02

Results are expressed as mean (n=3)

3.3 Water Activity (a_w) of the SCG Edible Cups

Water activity (a_w) content ranging from 0.68 to 0.78. Therefore, these might spoil from the microorganism.

3.4 Sensory Evaluation of the SCG Edible Cups

Shape, color, aroma, flavor, texture and overall liking were evaluated as present in table 4. All properties were given a score higher than six. As a result, the shape of the formula 2 present the highest points. The color of formula 1 indicated the highest. The aroma, flavor, texture and overall acceptance were present no significant outcome. However, formula 2 illustrates the highest point.

Table 3: Physical characterization: color value, water activity (a_w).

		Treatments				
		SEC 1	SEC 2	SEC 3	SEC 4	SEC 5
color value	<i>L</i> *	39.45	37.67	35.46	33.13	32.44
		±	±	±	±	±
		2.50 ^a	1.0.8 ^b	0.86 ^c	0.87 ^d	0.65 ^d
	<i>a</i> *	8.53	7.20	4.97	3.06	2.69
		±	±	±	±	±
		0.45 ^a	0.37 ^b	0.40 ^c	0.41 ^d	0.39 ^c
	<i>b</i> *	29.41	27.63	24.73	21.79	21.83
		±	±	±	±	±
		1.07 ^a	0.63 ^b	0.99 ^c	0.70 ^d	0.72 ^d
water activity (a _w)		0.77	0.78	0.75	0.77	0.68
		±	±	±	±	±
		0.02 ^a	0.02 ^a	0.01 ^a	0.08 ^a	0.07 ^b

Data are present as mean ± standard deviation (n=3). Different letters indicate significant differences (p<0.05) between the samples of the same column.

Table 4: Sensory evaluation (1-9 scale) of different SCG edible cup.

	Treatments				
	SEC1	SEC2	SEC3	SEC4	SEC5
Shape	6.93	7.00	6.13	6.53	6.70
	±	±	±	±	±
	1.36 ^b	1.41 ^a	1.66 ^b	1.63 ^{ab}	1.49 ^{ab}
Color	6.87	6.53	6.10	6.40	6.03
	±	±	±	±	±
	1.35 ^a	0.94 ^{ab}	1.19 ^{ab}	1.71 ^{ab}	1.83 ^{ab}
Aroma ^{ns}	6.13	6.20	6.17	6.43	6.20
	±	±	±	±	±
	1.43	1.38	1.32	1.33	1.42
Flavor ^{ns}	6.17	6.63	6.43	6.83	6.53
	±	±	±	±	±
	1.42	1.12	1.43	1.46	1.85
Texture ^{ns}	6.10	6.40	6.13	6.43	6.17
	±	±	±	±	±
	1.62	1.25	1.46	1.43	1.82
overall acceptatnce ^{ns}	6.67	7.03	6.73	6.80	6.77
	±	±	±	±	±
	1.09	1.13	1.23	1.32	1.71

Data are present as mean ± standard deviation (n=30). Different letters indicate significant differences (p<0.05) between the samples of the same column. The ns indicated non-significant data.

4 CONCLUSIONS

This study has demonstrated the potential of using SCG to apply the edible cup. The most proper formula of SCG edible cup is formula 2. Due to the highest sensory score such as shape, color, aroma, flavor, texture and overall acceptance. There are also the appropriate of water activity value and color value. This may present a value-added opportunity for SCG which is coffee by-products.

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