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Acceptability and Amino Acid Score of *Snack bar* of Mixed Whole-Wheat Varieties SO_{10} Flour with Soy Flour

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Abstract: *This research was conducted at the Laboratory of Engineering and Processing Technology of Agricultural Products, Laboratory of Chemistry, Biochemistry of Agricultural Products and Laboratory of Microbiology and Biotechnology of Agricultural Products, Department of Agricultural Technology, Andalas University. The purpose of this research was to determine the effect of mixing whole-wheat SO_{10} flour and soy flour towards the acceptability by panelists in organoleptic, amino acid score of the snack bar that produced. This study used a completely randomized design (CRD) with 5 treatments and 3 replications. Data were analyzed statistically used ANOVA and continued by Duncan's New Multiple Range Test (DNMRT) at 5% level. The treatments in this study are mixing wheat flour SO_{10} and soy flour with treatment A (100% wheat SO_{10} : 0% soy flour), treatment B (80% wheat SO_{10} : 20% soy flour), treatment C (60% wheat SO_{10} : 40% soy flour), treatment D (50% wheat SO_{10} : 50% soy flour) and treatment E (40% wheat SO_{10} : 60% soy flour). Based on the results of sensory analysis, the best products is treatment D (mixing 50% wheat SO_{10} : 50% soy flour) with the level of acceptance by panelists of color (3.7), aroma (3.1), texture (3.3) and taste (3.2). Water content (22.36%), protein content (17.30%), amino acid score (64.28) with the limiting amino acid methionine.*

Keywords: Snack bar, wheat SO_{10} flour, soy flour, amino acid score.

I. INTRODUCTION

Since 2008, Indonesia has been trying to develop wheat. One of the areas with development of wheat cultivation in Indonesia is in Alahan Panjang Region, Solok regency of West Sumatra. The area is good to grow one of wheat variety of Osivo Slovakia (SO_{10}).

Wheat SO_{10} developed in the form of wheat flour. Whole-wheat flour obtained by grinding whole grains along with the bran, germ and endosperm. The process of making whole-wheat flour without milling process will produce flour with minerals and fiber higher than wheat flour. Wheat also has a lower sugar content than other carbohydrate sources.

*Snack bar*s are solid food products which are bar-shaped and is a mixture of dry ingredients such as cereals, nuts, dried fruits are combined with the help of a binder. The binder can be a syrup, caramel, chocolate and others (Rahmi, 2003).

Soybean is one kind of nuts that are a source of vegetable protein which is widely consumed and easily obtainable. When viewed from the price, soybean is a cheap protein source. Dried soybean contain about 35% protein. Soybeans have started to processed, whether in form of finished food or semi-finished foods such as flour. In the form of flour, soybean has a protein content of 46% (Astawan, 2009). Whole wheat flour has a limiting amino acids such as lysine, but a high level of sulfur amino acids (methionine), whereas soy flour has a high level amino acid lysine, but the low number of sulfur amino acids (Winarno, 2004). It was expected by mixing wheat and soybeans flour can be a complementary of its amino acids that increase Amino Acid Score of product.

II. METHODOLOGY

Materials and tools

Materials used in this research is superior varieties SO_{10} of wheat flour gained from Alahan Panjang Regional, Solok regency. Soybeans gained from the market of Padang City. Additional materials used are pineapple to

make pineapple jam, commercial pectin, sugar, margarine, skim milk powder, salt, and eggs. The chemicals used include HCl solution (Merck), concentrated H_2SO_4, K_2SO_4, distilled water, NaOH (Merck),
The tools used in this study is an oven (Memmert), knives, analytical balance, blender, stainless steel pot, stir stick, containers, trays, aluminium foil, a microwave, and a 60-mesh sieve. The tools used for advanced research include glass tools, oven (Hot Aw; YCO-No1), hot plate, tissue, desiccator, aluminium cup, clamp plate, protein analyzer (Buchi KjeFlex), Kjeldahl bowl and filter paper.

Research Design
The design used in this study was completely randomized design (CRD) with 5 treatments and 3 replications. Data were analyzed using analysis of variance and continued by Duncan's New Multiple Range Test (DNMRT) at 5% level.
Treatment is mixing wheat SO_{10} flour and soy flour with ratio as follows:
A: 100% wheat SO_{10} : 0% soy flour
B: 80% wheat SO_{10} : 20% soy flour
C: 60% wheat SO_{10} : 40% soy flour
D: 50% wheat SO_{10} : 50% soy flour
E: 40% wheat SO_{10} : 60% soy flour

Implementation
Making of Soy flour Santoso, (2005) Modification
1. Soybeans sorted by removing the unknown object.
2. Soybeans soaked for eight hours, after soaked soybeans boiled at 100°C for 20 minutes.
3. Soybeans drained and discarded the husk.
4. Soybeans dried using an oven at a temperature of 60 ° C for 12 hours.
5. Soybeans finely ground, then sieved (60 mesh) to obtain soy flour.

Making of *Snack bar* (Workman, 2006 in Rufaizah, 2011)
1. Dry ingredients mixed: wheat SO_{10} flour, soy flour, milk powder, raisins and salt until mixed evenly.
2. After that, mixed with egg, pineapple jam, margarine, stir until they blended.
3. After the dough mixed well, put the dough into the pan.
4. The dough baked for 40 minutes at a temperature of 160^0C.
5. Then took the pan out from the oven and cooled, in order to obtain the *snack bar*.

The formulations in the making of *snack bar*s are based on the formulation made by Chandra (2010) with modifications shown in Table 1.
Table 1. Formulation of *Snack Bar*

Material	Treatments				
	A	B	C	D	E
Wheat flour (g)	100	80	60	50	40
Soy flour (g)	0	20	40	50	60
pineapple jam (g)	80	80	80	80	80
egg (g)	30	30	30	30	30
Skim milk powder (g)	20	20	20	20	20
raisins (g)	20	20	20	20	20
Margarine (g)	20	20	20	20	20

Source: Chandra, 2010 Modification

Table 2. Results of Analysis Whole-wheat SO_{10} flour, Soy flour and Pineapple Jam

Material	Wheat SO_{10} Flour	Soy flour	Pineapple jam
Water (%)	11.23	9.33	28.1
Ash (%)	1.99	2.44	-
fat (%)	2.04	25.72	-
Protein (%)	9.78	40.48	-
Carbohydrate (%)	74.96	22.30	-
Total Solids (%)	-	-	69.04

Table 3. Average of Organoleptic Value of *Snack Bar*s

Treatments	Average value			
	Taste	Color	Aroma	Texture
A(W 100%: S 0%)	3.2a	3.0a	2.8a	3.1a
B(W 80%: S 20%)	3.1a	3.3ab	2.9a	3.3a
C(W 60%: S 40%)	3.0a	3.8 c	3.0a	3.3a
D(W 50%: S 50%)	3.2a	3.7 bc	3.2a	3.3a
E(W 40%: S 60%)	2.8a	3.2a	2.8a	3.2a
CV (%) :	0.19	0.15	0.17	0.17

Description: (W: Wheat SO_{10}, S: Soy flour), Score values: 1 = lowest, 5 = Highest. Numbers in the same column followed by the same lowercase letter are not significantly different at 5% level according to DNMRT

Table 4. Essential Amino Acid Score of *Snack bar* Treatment D compared with amino acid reference

Asam Amino	*AA score of wheat	**AA score of soy	***FAO (1973) mg/g	AA score of Treatment D
Isoleucine	95	117.5	40	205.8
Leucine	95.7	110	70	189.9
Lysine	**41.8**	103.6	55	112.2
Methionine	48.5	**57.1**	35	**64.28**
Threonine	70	102.5	40	182.1
Valine	88	180	50	141.9

AA: Amino Acid; (*) Muchtadi, *et al*., 2010 ; (**) Muchtadi, 1993;
(***)Amino Acid reference by FAO (*Food and Agriculture Organization*)

Observation: The observations of raw material wheat SO_{10} flour, soy flour is the proximate analysis (water content, ash content, fat content, protein content, and carbohydrate content) (Sudarmadji et al., 1997), and pineapple jam (water, total solids) (Sudarmadji et al., 1997). the observation of *snack bar* was organoleptic test include aroma, color, taste and texture (Setyaningsih, et al., 2010), water content (Sudarmadji et al., 1997), protein content (Sudarmadji et al., 1997), amino acid analysis (Nollet, 1996)

III. RESULTS AND DISCUSSION

Raw material: The results of raw materials analysis can be seen in Table 2.
The results of protein content analysis of wheat SO_{10} flour and soy flour was 9.78% and 40.48%. The protein content of wheat flour produced, included in low protein flour. Low protein flour has a protein content of 8 to 9.5% (Bogasari, 1997). Protein content of whole-wheat SO_{10} flour and soy flour that produced in this study meet the SNI (01-3751-2009) of flour with a protein content of at least 7.00%. Soy is a highest protein source from the family *Leguminosae* content of 30.53 to 40% protein. The protein content of soy flour in this study was not much different with the protein content of soy flour resulted by Manulisma (2005), Ferawati (2009) and USDA (2008) respectively, amounting to 42.8%, 41.705 and 34.5%.
Total solids of pineapple jam in this study was 69.04%. Based on SNI 01-3746-2008, the value of total solids for the quality requirements of fruit jam at least 65%. Total solids of pineapple jam in this study met the SNI.

Organoleptic: The average of organoleptic value of *snack bar*s can be seen in Table 3
Taste: The average value of taste of *snack bar* made by mixing wheat SO_{10} flour with soy flour ranged from 2.7 to 3.2. Based on the assessment by panelists the most preferred taste is a *snack bar* formula A and D with the average value of 3.2. While the product with low acceptance of taste was product E with an average value of 2.7.
There are five basic tastes of sweet, bitter, salty and sour (Setyaningsih et al, 2010). Panelists described that the product *snack bar* has a sweet taste but not so dominant. The sweet taste came from pineapple jam and raisins that was mixed into the dough. The higher the addition of soy flour there was increasingly the bitter taste. Researched by Kurniawati (2012) said that the bitter taste of tempeh sweet bread can be caused by the hydrolysis of amino acids, especially amino acid of lysine that can cause a bitter taste.

Color: The average value of color of *snack bar* made by mixing wheat SO_{10} flour with soy flour ranged from 3.0 to 3.8. Based on the result, the most preferred color was product C (60% whole-wheat SO_{10} flour and 40%

soy flour) with an average value of 3.8. While the lowest acceptance of color was product A (100% wheat SO_{10} flour and 0% soy flour) with an average value of 3.0.
The color of *snack bar* products that produced was yellow-brown to brown. The more addition of soy flour, the *snack bar* become more yellowish. Wheat flour had color of brownish white, so it made a dough in a brown scale, while the soy flour produce a yellow color.

Aroma: The average organoleptic value of aroma by panelists ranged from 2.7 to 3.2. The most preferred aroma is the product D (50% whole-wheat SO_{10} flour and 50% soy flour) with an average value of 3.2. Panelists preferred the products that had a distinctive smell of wheat flour or soy flour that was not too strong.

Texture: The average value of texture of *snack bar* made by mixing wheat SO_{10} flour with soy flour ranged from 3.1-3.3. Based on the organoleptic test of texture, the most preferred product was product of treatment B, C and D with an average value of 3.3. While product that had lower acceptance of color was product A with an average value of 3.1.
According to panelists, all treatments produced *snack bar* with a dense and compact texture, it can be caused by the presence of raisins and pineapple jam. Organoleptic test radar can be seen in Figure 1.
Based on Table 3 and Figure 1 it can be concluded that the best products was on treatment D (50% wheat SO_{10} flour and 50% soy flour) with an average organoleptic value of taste 3.2, color 3.7, aroma 3.2 and texture 3.3.

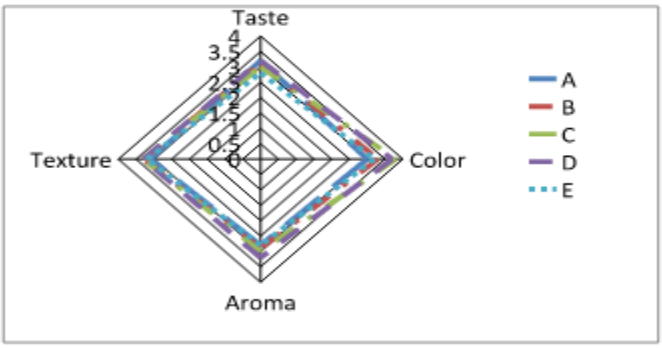

Figure 1. Organoleptic test radar of *Snack Bar*

Chemical analysis
Water content: Based on the analysis of variance known that mixing wheat SO_{10} flour and soy flour statistically had no significant effect on the water content of *snack bar*s that produced. The highest water content contained in the treatment E (40% wheat SO_{10} flour and 60% soy flour) was 23.36%. The lowest water content found in treatment C (60% wheat SO_{10} flour and 40% soy flour) of 19.16%. The higher the amount of soy flour added in the treatment tend to a higher water content. This is due to differences water content of the raw material wheat flour and soy flour used in this study.
The water content of *snack bar* is determined by the other ingredients that mixed, such as pineapple jam. According to Deman (1997) water level are also affected by drying or by the addition of water-soluble compounds such as sugar and jam.
Research done by Wijaya (2010) found that the water content of the *snack bar* of barley flour and tofu ranges from 12.50% to 38.88%. According to Inayati (1991), increase of protein, fiber and starch increases the amount of water retained during roasting, thereby increasing the water content. The bar chart of water content of the *snack bar* can be seen in Figure 2.

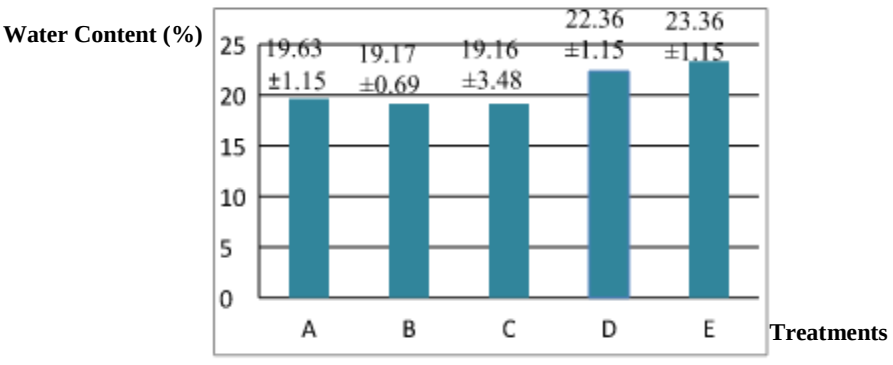

Figure 2. Bar chart of water content of the *snack bar*

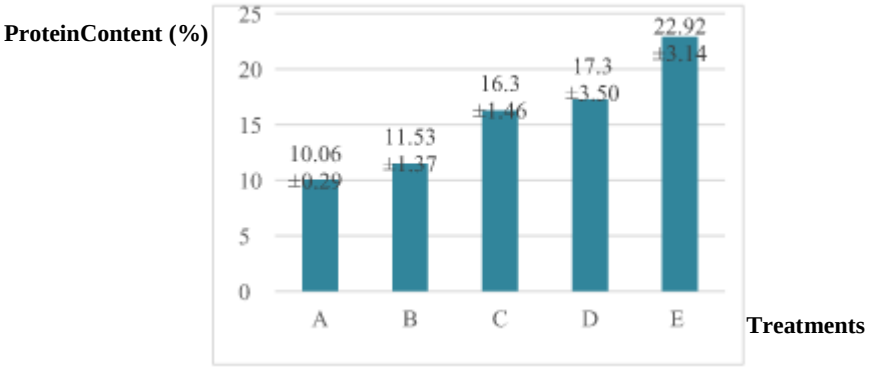

Figure 3. Bar chart of protein content of the *snack bar*

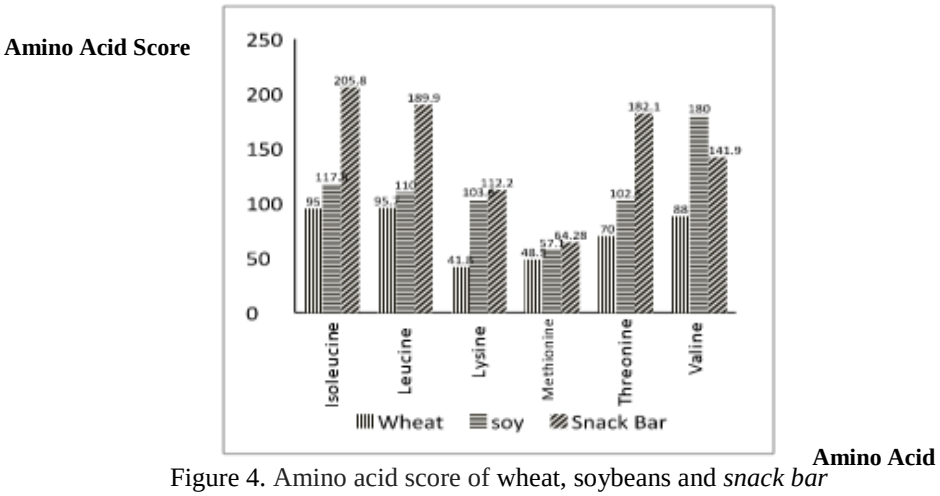

Figure 4. Amino acid score of wheat, soybeans and *snack bar*

Protein content: Based on the analysis of variance known that mixing wheat SO_{10} flour and soy flour statistically give a significant effect ($\alpha < 5$ %) on protein content of the *snack bar*. The highest levels of protein contained in treatment E (40% wheat SO_{10} flour and 60 % soy flour) of 22.92%. Lowest protein content in treatment A (100% wheat SO_{10} flour and 0 % soy flour) of 10.06 % . The higher the amount of soy flour in the treatment tends to a higher level of protein found in product . Increasing level of protein in *snack bar* products caused by a high level of protein content in soy flour. The bar chart of protein content of the *snack bar* can be seen in Figure 3.

Amino Acid Score: Amino acid score of wheat SO_{10} flour, soy flour and *snack bar*s can be seen in Table 4. Based on Table 4, amino acid score of wheat is 41.8 with limiting amino acid is lysine. While on soybeans, its amino acid score was 57.1 with limiting amino acid is methionine. Complementary between wheat and soybeans makes product with amino acid score of 64.2 with limiting amino acids is methionine. Mixing between wheat and soybeans increased amino acid score of *snack bar* that produced. The bar chart of amino acid score of wheat, soybeans and *snack bar* can be seen in Figure 4.

Conclusion

- Based on organoleptic test, treatment D (50% whole-wheat SO_{10} flour and 50% soy flour) is the best product with the average value of the color 3.7, aroma 3.1, texture 3.3 and taste 3.2.
- Mixing whole-wheat SO_{10} flour and soy flour in the making of *snack bar* gives no effect on water content but it can increase the levels of protein and amino acid score.

Suggestion

1. Need for researchers to improve the taste of the *snack bar* with addition of flavor to reduce the bitter taste.
2. Recommended for subsequent researchers to analyze the shelf life of *snack bar* and the effect of storage on nutrition and food safety of *snack bar*.
3. Expected for subsequent researchers to analyze the levels of vitamins, antioxidants and minerals.

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