PREDICTION OF STUDENTS PREFERENCES ON DRY WHOLE MILK BY SENSORY AND ANALYTICAL MEASURES

Tridjoko Wisnu Murti[1]

ABSTRACT

The consumption rate of milk in Indonesia is low, due to lactose intolerance, high price, and strange flavor of milk for consumers. Most of the commercial milk products are in the form of dry milk powders. This study was to obtain whether prediction of consumers liking of dry whole milk powders could be made by sensorial descriptive analysis and preference test using chi-square analyses, and analytical measures of physic-chemical criteria (pH, acidity of milk, solubility index, index of lipid acidity, and free fatty acid). Seventy-eight students of three groups (D, P, and M) have detected the flavor intensity (bitter, sweet, salt, acid, rancid, and rusted-off flavor) of 4 dry whole milk products (W1, W2, W3, and W4). The results indicated that the intensity scores of saltiness, rancidity, and rusted-off were all depended significantly ($P<.01$) on the brand type, and majorities of them (>70%) have considered that all milk products were sensorial still in standard quality. Analytical measures have presented normal value as concomitantly with the sensorial descriptive and preference test. Nevertheless, they have been agreed that the starting point of milk deterioration would come from rancidity and rusted off-flavor due to lipid auto oxidation of milk. They have presented low score of preference among 1.49-1.59 of 4 as maximum score.

Key words: Dry whole milk, Sensorial descriptive, Preferential score, Analytical measure

INTRODUCTION

Most of the milk products in Indonesia are in the form of milk powder for babies, pregnant women, and the sick. These products are storage for a long time since it's produced (2-2.5 years), and there fore some changes can take place. It is well known that flavor changes in dry milk (whole or skim milk) during processing (by conventional spray drying, foam spray drying, or wheel atomization drying) and storage is mainly due to lipid oxidation (Min *et al.*, 1990) and non enzymatic brown reactions (Troyano *et al.*, 1994). This oxidation is especially to polyunsaturated fatty acid (PUFA) of milk fat globule membrane (Chen and Nawar, 1991), leading to rancidity or rusted off-flavor. It is important also to note that the Maillard reaction caused by heating process during the manufacture of milk powder, is a predominant reaction in dried food and causes of deterioration of skim milk powder during storage, loading to increase galactose and glucose contents (Troyano *et al.*, 1994) that will appreciate differently by consumers. These changes suggest that lactose transformation during storage could raise the sweet intensity of milk powder due to different intensity of sweetness of lactose, glucose, and galactose by which each is equivalent to 0.3-0.4; 0.7 and 0.6 of sucrose standard, respectively (Barnes *et al.*, 1991).

Adolescents and students are a critical period that brings many changes at all levels. Pupil's age among 10-12 years old have started to understand how nutrients are incorporated into diet and how they could affect the body. They can link food and health more efficiently, rather than hearing what their parents believe is good or bad for them. As far as food intake is concerned, very little is known about the changes of preferences induced by puberty: Few market studies have been led for this age group because of its reputation for capriciousness (Nu *et al.*, 1996). How ever, it would be interesting to better understand the period of

[1] Faculty of Animal Science, Gadjah Mada University, Yogyakarta, Indonesia

adolescents. Adolescents and students' habits and preferences that might be condition for the future choices of the consumers, are become a potential market for any products, included dry milk. They have a great influence on family orientation to the market (Kimmel *et al.*, 1994). In recent years, very little nutritional studies have measured partially food choices, nutritional status, and consumption of food, included from animal products (Hermanto *et al.*, 1995; Florentino and Pedro, 1992). The elasticity of milk demand in Indonesia is considered positive to income rise, but not elastic to price change that limit the consumption rate of milk as a premium food.

Other than price, this is also limited by the lactose intolerance problem for majority of adults and strange flavor of milk for inhabitant's population that psychologically habituated and close to the flavor vegetable products. Product quality and consumer satisfactions of flavor are paramount to increase the sales of various types of milk products (Carrier and Riskey, 1990).

We have studied the sensory of commercial dry whole milk powder to obtain more information about the acceptability and capacity of students as consumers to predict the quality of whole milk powder through descriptive sensorial test and to determine whether analytical measurement of pH, titratable acidity of milk, solubility index, and acidity index of lipid relates or concomitant to consumer's preference.

MATERIALS AND METHODS

Subjects

The test group was composed of 78 Indonesian students, recruited by teachers at 2 public elementary school (one at rural area called group D another at urban area of Yogyakarta as group P) and student at some universities who lives at Karangmalang, Yogyakarta, Indonesia, called as group M. Their ages range among 10 to 23 years old.

Four dry whole milk powder (W1, W2, W3, and W4) that are readily available in Yogyakarta city regency marketplace, were bought from factory or outlets and evaluated. Samples were chosen with the latest expiration date ranging from 18-30 month.

Sensory Methods

Sensory characteristics of products were evaluated using sensorial descriptive analysis (Kroll, 1990). Preference test, which is to determine the acceptability of consumers, was done using classical hedonic test. Evaluation was performed by a trained panel of students (26 pupils of rural publics elementary school, 26 pupils of urban public

Table 1. Standard of tastes and odor used in training

Type of aroma	Intensity scale of aroma and preferences[a]					Substances uses
	0	1	2	3	4	
	none	little	moderate	.....	very	
Tastes						
Bitter	0	0.05	0.1	0.2	0.4	g caffeine/l
Sweet	0	0.75	1.5	3	6	g sucrose/l
Salt	0	0.375	0.75	1.5	3	g NaCl/l
Acid	0	0.187	0.375	0.75	1.5	ml lactic acid/l
Odors						
Rancid	0	0.575	1.15	2.3	4.65	g butyric acid/l
Rancid {	0	2.5	5	10	20 }	g ascorbic acid/l
			+			
{	0	0.5	1.0	2.0	4 }	mg $CuSO_4$/l

[a] Modified from AFNOR (1981) by Murti (1994)

elementary school, and 26 of university students). Thirty 1 h-training and practices session of 4 basic testes (acid, sweet, salt, and bitter) and of 2 type odor test (rancidity and rusted-off flavor) using 5 scale of intensity and preference score were conducted using standard of flavor as presented in Table 1. The lower score of descriptive sensorial and hedonic test is to keep pupils having the capacity to describe their choice easily (Kimmel *et al.*, 1994). The training of taste was accorded to Watts *et al.* (1989).

Analytical Measurements

Titratable acidity was measured by taking 9 ml of sample's solution (10% w/v), added by 1% phenolphtalene in alcohol (95%), and titrated by 0.1N NaOH. It was expressed in percentage lactic acid-equivalent per L of products (Kim *et al.*, 1982). pH was measured by pH meter.

Solubility index was measured using the method of Kim *et al.* (1982). In which 130 g of milk powders was poured into 900 ml distillate water. It was taken about 40 ml of this, centrifuged at 3,000 rpm during 15 minutes. The supernatant was then removed and the residue was dissolved again with 40 ml of distillate water, re-centrifuged at 3,000 rpm, 10 mi. The last residue was then oven-dried (105 °C) during 15 h.

$$\text{Solubility} = \frac{\text{Sample weight} - \text{Residue weight after oven}}{\text{Initial sample weight}}$$

Acid index of lipid that was used to measure the index of lipolysis was calculated using method of Weber (1985). Milk product was separated from its lipids. The fat was then removed by piping fat as supernatant, centrifuged at 1,500 rpm, oven at 95 °C (12 hours) to eliminate water. Five grams of sample's cream was then removed to Beaker glass to be added by 50 ml of alcohol 95% and 2% of phenolphtalene, and titrated by 0.1N NaOH. Acidity index (AI) was calculated as :

$$\text{mL AI} = \frac{\text{mL NaOH} \times \text{N NaOH} \times 40}{\text{Sample weight}}$$

Oleic acid as the major of free fatty acid in milk is about 35.5%. So the acidity index of oleic acid was then multiplied by 0.355.

We performed Chi-square test to study non-parametric data i.e., the independency of flavor intensity or preference on brand mark of whole milk. In the results section, we only present the significant effect and we examined the results about percentage of panelist whom choused scale of intensity of flavor 0 and 1 (indicator the milk is in normal or standard quality) using complete randomized design (CRD) as in Astuti (1981).

RESULTS AND DISCUSSION

Intensity of Flavor

Scale of intensity of flavor detected by Sensorial Descriptive test used in this study was 5 scale with maximum score was 4. This was important to eliminate the afraid of pupils describing their choices (Kimmel *et al.*, 1994). The results indicated that unless the independency of sweetness, bitterness, and acidity, the students choices on flavors were depended on brand mark.

It seemed that students as consumers have divided their choices of the flavor of each brand type as presented in Table 2, after training. In general, all groups have considered that saltiness, rancidity, and rusted-off flavors were depended on the brand type. Sweetness was considered as the most appreciate by consumers given highest score of intensity.

Individually of the group, group panelist M (student at University) were the least sensitive among them to all of products and they could not differentiated flavor of each brand, followed by student at city (group P) whose have considered only sweet taste that depended on the brand type. While student at village (group D) were sensitive to detect sweetness, rancidity, and rusted off-flavor that depended significantly on the brand type ($P \leq .01$). It was due probably that student at village are habituated to the off-

Table 2. Average score of flavor intensities and Chi^2 values

Groups and products	Tastes			Odors		
	Bitter	Sweet	Salt	Acid	Rancid	Rusted
Group M						
W1	0.52	1.77	0.48	0.52	0.55	0.85
W2	0.48	1.77	0.44	0.55	0.52	0.85
W3	0.59	1.66	1.18	0.74	0.70	0.41
W4	0.85	1.96	1.11	0.70	1.07	0.88
x	0.61	1.77	0.8	0.63	0.71	0.75
Chi^2 value	9.66	10.15	15.16	8.13	15.09	15.08
Group D						
W1	0.69	1.15	0.62	0.74	0.22	0.11
W2	0.96	0.78	0.71	0.69	0.92	0.92
W3	1.03	1.67	1.12	1.22	1.42	0.92
W4	1.34	1.48	1.33	1.30	1.54	1.15
x	1.01	1.27	0.95	0.98	1.03	0.77
Chi^2 value	20.74	20.5	17.94	17.04	46.4**	27**
Group P						
W1	0.73	1.73	0.87	0.96	0.73	nd
W2	0.96	0.61	0.42	0.73	0.5	nd
W3	0.77	1.65	0.75	0.76	0.5	nd
W4	0.65	1.65	0.88	0.61	1.0	nd
x	0.78	1.4	0.73	0.76	0.68	nd
Chi^2 value	7.55	27.9**	9.65	10	8.06	nd
All average	0.79	1.48	0.82	0.79	0.8	0.76
Chi^2 value	16.73	20.04	36.45**	16.8	32.05**	23.16*

*(P<.05); **(P<.01); nd=not detected completely

flavor by making some products as a toy using waste packaging material.

Sensorial descriptive test of complex flavors need sensorial experience in the brain memory of consumers in which pupils lack on (Kimmel *et al.*, 1994). The first memory of babies to know about the taste is perhaps sweetness of sugars that important source of energy and fortunately undegraded substance. Milk industries tend to add sugar for attracting children as major consumers of dry milk. The papilla nerve for sweet response is placed in the front of human tongue (Bartoshuk, 1992). While for adults, they have more experience and vocabulary words to express their knowledge and sensitivity on flavors. When the panelist were asked for their opinion if the products have been changed its qualities during storage, the results indicated that majority of them (>70%) have considered that milk products were still in normal quality by chosen the score of flavor intensity 0 and 1, as general indicator of normal quality, Table 3.

Nevertheless, all groups panelist has presented their opinion that deviation of quality will come from sweetness of products, by 53.99% of panelist. The higher score chosen by panelists group P than group D and M were perhaps that they have been habituated to consume more milk, as indicated by higher elasticity on milk demand in city with more money circulated, than in rural areas (Hermanto *et al.*, 1995).

Preferential Test

As well as the sensorial descriptive test, the data of preferential test were not

Table 3. Percentage of consumers chosen the flavor intensity scores low (0 & 1 indicated a standard quality)

Variables of flavor	Group of panelist			Average
	D	P	M	
Tastes				
Bitter	74.01	72.00	82.40	76.14
Sweet	59.22	62.00	40.70	53.99
Salt	71.88	82.5.0	73.15	75.84
Acid	72.51	76.00	81.48	76.66
Odors				
Rancid	70.37	78.53	79.65	76.18
Rusted-off	77.78	87.50	74.07	79.78
Average	70.96[a]	76.43[a]	71.91[a]	

[a] The same superscript at the same row have indicated indifferently (P>.05)

parametric data and should be analysed by Chi^2 (Watts *et al.*, 1989; Astuti, 1981).

The results indicated that all groups have considered that the dependency of flavor preference was on brand type. Individually of the group, students at universities have considered that their preference were depended significantly (P<.05) on brand type. On the other side, pupils lives in rural area (D) or in city (P) have all considered that their preferences on taste were not depended on the brand type. The results were in Table 4.

These results indicated that the score of preference test were only between 1.49-1.58 (little like to moderately like) by more than 70% of them. Product W4 has been detected, as the least preferred by panelists. Sensorial descriptive response may be related to consumer acceptability. This sensorial descriptive using panel groups has been considered had a good or better correlation with consumer acceptability rating as the traditional dairy judging (Lawless and Claassen, 1993).

Analytical Measurement

The quality of milk powders (skim or whole milk) that produced using different methods has been classed according to physico-chemistry criteria. Solubility index is one of method used for detecting the physical quality. The results (Table 5) indicated that in general all of products tested have had solubility index less than its normal index, according to Kim *et al.* (1982). Solubility index less than 99.34 is considered to be as little denaturated products or not normal.

Acidity of milk products, pH and acidity indexes of milk fat or free fatty acids

Table 4. Average score of preferential test of products

Brand Type	Group of panelist			Average
	M	D	P	
W1	1.36	1.95	1.25	1.52
W2	1.38	1.36	1.07	1.27
W3	1.42	1.38	1.59	1.46
W4	1.81	1.60	1.62	1.68
Average	1.49[a]	1.57[a]	1.58[a]	

[a] The same superscript at the same row have indicated indifferently (P>.05)

Table 5. Average results of analytical measure of products

Item	Products			
	W1	W2	W3	W4
pH	6.42	6.44	6.48	6.50
Acidity of milk (%)	0.12	0.13	0.13	0.09
Solubility index (%)	91.89	87.41	94.73	88.13
Index of lipid acidity (ml)	0.48	0.89	0.95	1.2
As index of free fatty acid (ADV) (ml)	0.17	0.31	0.34	0.42

were all in normal quality. Product W4 have had a limit of acidity index of fat at 1.2. Kim *et al.* (1982) said that acidity indexes 1.2 ml has been as starting point of rancidity and rancid after 8 ml.

When it was converted to acidity of free fatty acid (multiplied by 0.355), it has been found that all products were at normal standard because the limit of acid degree value (ADV) 2, considered by Bodyfelt (1988) in Lawless and Claassen (1993) as a real starting point of consumer complaints.

CONCLUSION

All three group of trained panelists have considered that all products were still sensorial in standard quality. Their capacity to detect the quality of whole milk product were concomitant with analytical measurements on physico-chemical criteria (pH, solubility index, milk acidity, acidity index of fat and free fatty acid). Nevertheless, consumers predicts the breakdown to off-flavor compounds will come from rancidity and rusted off-flavor.

It was concluded that the worst the quality of flavor (tastes and odors), the less accepted by three group of students panelists acted as trained consumers.

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