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Effect of different consumer parameters on sensory attributes of the developed linseed (*Linum Usitatissimum*) products

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Abstract

One-hundred consumers were selected from both sexes belonging to the age group of under 10 years to 60 years of subjects were chosen for finding the acceptance of the developed omega 3 designer foods (chappathi, dalia porridge, cookies, omapodi and chidwa laddu). Acceptance testing was used to determine how much each sample was liked based on a 9-point hedonic scale. Consumers were asked to answer a demographic questionnaire at the end of testing. Results on effect of age on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that children under the age of 10 years liked dalia porridge (8.66), subjects under the age of 11-25 years liked cookies very much, persons under the age group of 26-40 years liked omapodi and persons belonged to the age group of 41-56 years liked chidwa laddu. Results on Effect of Gender on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that male subjects liked chappathi (8.66) very well and female subjects liked cookies (8.53) very well. Results on Effect of Educational status on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that middle school consumers liked chappathi (8.66) very much, high school subjects liked cookies (8.53) very much and college subjects liked dalia porridge (8.87) very much. Results on Monthly Income on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that low income group liked chappathi (8.66) very much, middle income group liked cookies (8.53) very much and high income group liked dalia porridge (8.87) very much. Results on the response regarding the consumer attitude about quality and healthiness of linseed among the selected consumers revealed that 28.6 percent of them agree strongly that linseed are rich source of omega 3 fatty acids, 40 percent of them agree that linseed may cause vomiting. Around 25.6 percent of them disagree somewhat that they would not let their children eat linseed as I would worry about their health and 22.9 percent of them disagree strongly that linseed is only fit for cattle food not human consumption. Results on the response regarding the consumer attitude about linseed and its attributes among the selected consumers revealed that 28.5 percent of them agree strongly that linseed is too oily, 28.5 percent of them agree strongly that they are not confident that they could cook linseed. Around 34.2 percent of them disagree strongly that they do like the look of linseed.

Keywords: *Linum usitatissimum*, Physicochemical, Nutrients, Seeds

1. Introduction

The emphasis on health and nutrition increased in the late twentieth century which provided a tremendous opportunity to the food manufacturers for marketing healthy food products. At present functional foods play a significant role in the development of functional foods. The consumers demand has increased for a product with taste, safety, convenience and nutrition. Thus nutrition has emerged an added dimension in the chain of food product development (Shahidi, 2002) [1]. There are many foods which are associated for health benefits and used or sold under a variety of names like designer foods, novel foods, medical foods, nutraceutical and functional foods.

Bridging the gap between increasing food consumption and production is amongst the most challenging tasks round the globe especially in developing countries. The existing problems of food security and malnutrition coupled with escalating population, uncertain crop yield and high cost animal based food supplies have urged to identify and incorporate unconventional food sources in diet formulations to improve the prevailing situation by introducing value added products. Flax is considered a functional food or source of

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functional ingredients, because it contains alpha-linolenic acid (Bozan and Temelli, 2008) ^[2], lignans and polysaccharides (other than starch), all of which have positive effects in disease prevention. Although scientific evidence supports flaxseed consumption, many people are still unaware of the benefits provided by this product and its possible applications in the production of foodstuffs (Udeniqwe, *et al.*, 2009) ^[3].

Flaxseed in particular has been consumed throughout the world for centuries. Today, flaxseed is used as a good source of soluble and insoluble fiber to reduce blood cholesterol and promote laxation (Payne, 2000) ^[4]. In addition, an emerging body of research demonstrates potential benefits of an increased consumption of omega-3 fatty acids on attenuation of inflammatory diseases [i.e., osteoporosis]. The imbalance in the essential fatty acid ratio can be rectified only through consumption of omega-3 rich foods such as linseed which contains three times more omega-3 fatty acids than omega-6 fatty acids. In the present study to find consumer acceptability of different products (chappathi, dalia porridge, cookies, omapodi and chidwa laddu) through hedonic evaluations.

Materials and Methods

Consumer Acceptance Test

a) Consumer Recruitment

One-hundred consumers were recruited from Thanjavur Medical College, Thanjavur. Criteria for recruitment included the following: (1) they had to be at least 18 years of age, (2) they were not allergic to wheat, rice, butter, sugar, corn syrup, eggs, milk, vanilla, and cream of tartar, and (3) they were available for the required 20 minutes to complete the survey.

b) Sensory Methodology

Consumers were asked to sign a consent form (as required by Periyar University). Acceptance testing was used to determine how much each sample was liked based on a 9-point hedonic scale for a set of attributes: overall liking, flavor, and texture where 9=like extremely and 1=dislike extremely. In addition, consumers were asked what they like and dislike about each sample (comment section). Consumers were asked to answer a demographic questionnaire at the end of testing. The following questions were asked: "particular linseed product" consumption, age, and gender.

Statistical analysis

The data was compiled and analyzed by using statistical methods. The results are represented as Descriptive statistics mean, standard error mean, standard deviation, one way ANOVA, followed by Duncan's multiple comparison tests. A p-values <0.05 were considered significant. Differences in baseline characters were analyzed by t-test. Paired comparison test are computed using statistical software IBM SPSS Statistics (Version 19, 2010). Duncan's multiple range tests were applied to determine the significant differences between samples. Design Expert version 8.0 was used to analyze the optimization techniques.

Result and Discussion

Consumer Acceptability Test

Consumer demands for convenient, inexpensive, nutritious and ready to eat products result in value addition. Utilization in diversified ways by converting them into a variety of

products such as infant foods, health foods/mixes, convenience foods and specialty foods, make a significant impact on consumer acceptability.

An investigation on consumer acceptability of tropical Ghanaian QPM was conducted by Ahenkora *et al.*, (1999) ^[5]. Okezie *et al.*, (2003) ^[6]. extracted maize by addition ripe banana pulp at various proportions (0-50%). It was reported that addition of banana to all the mixes had significantly lower values of crude protein (5.37-5.93%). A similar trend was also noticed for the fat content and decreased from 4.25 per cent for maize flour to 2.87 per cent. The ash content, however, increased with increasing level of banana substitution from 0.03 to 2.42 per cent. A study on soy-fortified maize *sattu* was conducted by Deshpande *et al.*, (2004) ^[7]. Soybean, maize and Bengal gram were blended in different proportions to prepare nutritious and ready to eat snack chemical analysis of the products revealed that the protein (18 to 27%) fat (6.2 to 10.8%) and ash (2.74 to 3.32%) contents varied in the *sattu* samples with soy fortification, whereas carbohydrate content decreased with level of soya incorporation in maize *sattu* (62.6 to 48%).

Effect of Different Consumer Parameters on Sensory Attributes of the Developed Linseed Products

The effect of different consumer parameters on sensory attributes of the developed products are discussed as follows

Effect of Age of Sensory Attributes of the Linseed Products

The effect of age sensory attributes of the linseed products is given in table-1. Results on effect of age on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that children under the age of 10 years liked dalia porridge (8.66), subjects under the age of 11-25 years liked cookies very much, persons under the age group of 26-40 years liked omapodi and persons belonged to the age group of 41-56 years liked chidwa laddu.

Effect of Gender on Sensory Attributes of the Linseed Products

The effect of gender on sensory attributes of the linseed products is given in table-2. Results on Effect of Gender on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that male subjects liked chappathi (8.66) very well and female subjects liked cookies (8.53) very well.

Effect of Educational Level on Sensory Attributes of the Linseed Products

The effect of educational level on sensory attributes of the linseed products is given in table-3. Results on Effect of Educational status on the sensory attributes (overall acceptability) of the processed linseed powder incorporated products revealed that middle school consumers liked chappathi (8.66) very much, high school subjects liked cookies (8.53) very much and college subjects liked dalia porridge (8.87) very much.

Effect of Monthly Income on Sensory Attributes of the Linseed Products

The effect of monthly income on sensory attributes of the linseed products is given in table-4. Results on Monthly Income on the sensory attributes (overall acceptability) of the

processed linseed powder incorporated products revealed that low income group liked chappathi (8.66) very much, middle income group liked cookies (8.53) very much and high income group liked dalia porridge (8.87) very much.

Table 1: Effect of Age of Sensory Attributes of the Linseed Products

Age Groups	Linseed Product	Sensory Attributes								Overall Acceptability
		Appearance	Color	Flavour	Taste	Texture	Juiciness	Mouth Feel	Tenderness	
Under 10 years	Dalia Porridge	8.83±0.40	8.66±0.51	8.50±0.54	8.16±0.40	8.33±0.51	7.66±0.81	8.20±0.67	8.00±0.75	8.66±0.61
	Chappathi	8.66±0.51	8.33±0.51	8.50±0.83	8.83±0.40	8.50±0.54	7.83±0.75	8.00±0.89	8.00±0.63	8.32±0.51
	Cookies	8.83±0.40	8.83±0.40	8.66±0.51	8.66±0.51	8.33±0.81	7.83±0.40	8.16±0.40	8.33±0.81	8.33±0.40
	Chidwa Laddu	8.66±0.51	8.50±0.54	8.66±0.51	8.50±0.54	8.33±0.51	7.66±0.51	8.50±0.83	8.00±0.00	8.16±0.40
	Omapodi	8.50±0.54	8.50±0.54	8.33±1.03	7.83±0.75	7.50±0.54	8.00±0.89	8.16±0.75	7.66±0.51	8.33±0.51
11 to 25 years	Dalia Porridge	8.46±0.51	8.40±0.50	8.60±0.73	8.46±0.63	8.26±0.70	7.73±0.45	8.20±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.48	8.53±0.51	8.40±0.63	8.26±0.59	8.13±0.63	8.06±0.79	8.06±0.59	8.00±0.65	8.40±0.50
	Cookies	8.66±0.48	8.53±0.51	8.60±0.50	8.40±0.50	8.26±0.59	8.13±0.83	8.20±0.67	8.26±0.70	8.53±0.51
	Chidwa Laddu	8.66±0.48	8.66±0.48	8.53±0.63	8.33±0.48	8.06±0.25	8.13±0.83	8.13±0.83	8.20±0.56	8.40±0.50
	Omapodi	8.73±0.59	8.60±0.63	8.33±0.48	8.06±0.59	8.00±0.65	7.80±0.77	7.80±0.86	7.93±0.70	8.20±0.56
26 to 40 years	Dalia Porridge	9.00±0.00	9.00±0.00	8.50±0.53	8.25±0.70	8.50±0.75	8.25±0.46	8.12±0.83	8.12±0.64	8.87±0.35
	Chappathi	8.87±0.35	8.75±0.46	8.50±0.75	8.37±0.74	8.37±0.51	7.62±0.74	8.12±0.64	7.87±0.64	8.50±0.53
	Cookies	8.50±0.75	8.62±0.51	8.50±0.53	8.37±0.51	8.12±0.64	7.75±0.46	8.37±0.74	7.75±0.70	8.50±0.53
	Chidwa Laddu	8.75±0.46	8.75±0.46	8.12±0.64	8.25±0.86	8.12±0.83	7.50±0.75	8.25±0.46	8.00±0.92	8.50±0.53
	Omapodi	8.62±0.51	8.87±0.35	8.25±0.46	8.12±0.64	8.00±0.53	7.87±0.83	8.12±0.35	8.00±0.92	8.90±0.53
41 to 56 years	Dalia Porridge	8.33±0.51	8.33±0.51	8.66±0.51	7.83±0.75	7.83±0.40	7.50±0.54	7.83±0.98	7.66±0.51	8.00±0.00
	Chappathi	8.66±0.51	8.66±0.51	8.50±0.54	8.00±0.63	7.83±0.40	7.66±0.51	8.00±0.89	7.66±0.81	8.16±0.40
	Cookies	8.50±0.54	8.66±0.51	8.66±0.51	8.33±0.51	8.00±0.63	8.00±0.89	7.66±0.81	8.00±0.89	8.33±0.51
	Chidwa Laddu	8.83±0.40	8.50±0.54	8.50±0.54	8.16±0.75	8.16±0.75	7.83±0.40	8.16±0.75	8.33±0.81	8.50±0.54
	Omapodi	8.33±0.81	8.33±0.81	8.16±0.75	7.66±0.81	7.83±0.75	8.33±0.51	8.00±0.89	8.16±0.40	8.00±0.63

Table 2: Effect of Gender on Sensory Attributes of the Linseed Products

Gender	Linseed Product	Sensory Attributes								Overall Acceptability
		Appearance	Color	Flavour	Taste	Texture	Juiciness	Mouth Feel	Tenderness	
Male	Dalia Porridge	8.83±0.40	8.66±0.51	8.50±0.54	8.16±0.40	8.33±0.51	7.66±0.81	8.20±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.51	8.33±0.51	8.50±0.83	8.83±0.40	8.50±0.54	7.83±0.75	8.00±0.89	8.00±0.63	8.66±0.51
	Cookies	8.83±0.40	8.83±0.40	8.66±0.51	8.66±0.51	8.33±0.81	7.83±0.40	8.16±0.40	8.33±0.81	8.33±0.40
	Chidwa Laddu	8.66±0.51	8.50±0.54	8.66±0.51	8.50±0.54	8.33±0.51	7.66±0.51	8.50±0.83	8.00±0.00	8.16±0.40
	Omapodi	8.50±0.54	8.50±0.54	8.33±1.03	7.83±0.75	7.50±0.54	8.00±0.89	8.16±0.75	7.66±0.51	8.33±0.51
	Dalia Porridge	8.46±0.51	8.40±0.50	8.60±0.73	8.46±0.63	8.26±0.70	7.73±0.45	8.20±0.67	8.00±0.75	8.33±0.61

Female	Chappathi	8.66±0.48	8.53 ±0.51	8.40 ±0.63	8.26 ±0.59	8.13 ±0.63	8.06 ±0.79	8.06 ±0.59	8.00±0.65	8.40±0.50
	Cookies	8.66±0.48	8.53 ±0.51	8.60 ±0.50	8.40 ±0.50	8.26 ±0.59	8.13 ±0.83	8.20 ±0.67	8.26±0.70	8.53±0.51
	Chidwa Laddu	8.66±0.48	8.66 ±0.48	8.53 ±0.63	8.33 ±0.48	8.06 ±0.25	8.13 ±0.83	8.13 ±0.83	8.20±0.56	8.40±0.50
	Omapodi	8.73±0.59	8.60 ±0.63	8.33 ±0.48	8.06 ±0.59	8.00 ±0.65	7.80 ±0.77	7.80 ±0.86	7.93±0.70	8.20±0.56

Table 3: Effect of Educational status on Sensory Attributes of the Linseed Products

Educational status	Linseed Product	Sensory Attributes								
		Appearance	Color	Flavour	Taste	Texture	Juiciness	Mouth Feel	Tenderness	Overall Acceptability
Middle school	Dalia Porridge	8.83±0.40	8.66 ±0.51	8.50 ±0.54	8.16 ±0.40	8.33 ±0.51	7.66 ±0.81	8.20 ±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.51	8.33 ±0.51	8.50 ±0.83	8.83± 0.40	8.50 ±0.54	7.83 ±0.75	8.00 ±0.89	8.00±0.63	8.66±0.51
	Cookies	8.83±0.40	8.83 ±0.40	8.66 ±0.51	8.66 ±0.51	8.33 ±0.81	7.83 ±0.40	8.16 ±0.40	8.33±0.81	8.33±0.40
	Chidwa Laddu	8.66±0.51	8.50 ±0.54	8.66 ±0.51	8.50 ±0.54	8.33 ±0.51	7.66 ±0.51	8.50 ±0.83	8.00±0.00	8.16±0.40
	Omapodi	8.50±0.54	8.50 ±0.54	8.33 ±1.03	7.83 ±0.75	7.50 ±0.54	8.00 ±0.89	8.16 ±0.75	7.66±0.51	8.33±0.51
High School	Dalia Porridge	8.46±0.51	8.40 ±0.50	8.60 ±0.73	8.46 ±0.63	8.26 ±0.70	7.73 ±0.45	8.20 ±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.48	8.53 ±0.51	8.40 ±0.63	8.26 ±0.59	8.13 ±0.63	8.06 ±0.79	8.06 ±0.59	8.00±0.65	8.40±0.50
	Cookies	8.66±0.48	8.53 ±0.51	8.60 ±0.50	8.40 ±0.50	8.26 ±0.59	8.13 ±0.83	8.20 ±0.67	8.26±0.70	8.53±0.51
	Chidwa Laddu	8.66±0.48	8.66 ±0.48	8.53 ±0.63	8.33 ±0.48	8.06 ±0.25	8.13 ±0.83	8.13 ±0.83	8.20±0.56	8.40±0.50
	Omapodi	8.73±0.59	8.60 ±0.63	8.33 ±0.48	8.06 ±0.59	8.00 ±0.65	7.80 ±0.77	7.80 ±0.86	7.93±0.70	8.20±0.56
College	Dalia Porridge	9.00±0.00	9.00 ±0.00	8.50 ±0.53	8.25 ±0.70	8.50 ±0.75	8.25 ±0.46	8.12 ±0.83	8.12±0.64	8.87±0.35
	Chappathi	8.87±0.35	8.75 ±0.46	8.50 ±0.75	8.37 ±0.74	8.37 ±0.51	7.62 ±0.74	8.12 ±0.64	7.87±0.64	8.50±0.53
	Cookies	8.50±0.75	8.62 ±0.51	8.50 ±0.53	8.37 ±0.51	8.12 ±0.64	7.75 ±0.46	8.37 ±0.74	7.75±0.70	8.50±0.53
	Chidwa Laddu	8.75±0.46	8.75 ±0.46	8.12 ±0.64	8.25 ±0.86	8.12 ±0.83	7.50 ±0.75	8.25 ±0.46	8.00±0.92	8.50±0.53
	Omapodi	8.62±0.51	8.87 ±0.45	8.25 ±0.46	8.12 ±0.64	8.00 ±0.53	7.87 ±0.83	8.12 ±0.35	8.00±0.92	8.50±0.53

Table 4: Effect of Monthly Income on Sensory Attributes of the Linseed Products

Monthly Income	Linseed Product	Sensory Attributes								
		Appearance	Color	Flavour	Taste	Texture	Juiciness	Mouth Feel	Tenderness	Overall Acceptability
Low Income	Dalia Porridge	8.83±0.40	8.66 ±0.51	8.50 ±0.54	8.16 ±0.40	8.33 ±0.51	7.66 ±0.81	8.20 ±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.51	8.33 ±0.51	8.50 ±0.83	8.83± 0.40	8.50 ±0.54	7.83 ±0.75	8.00 ±0.89	8.00±0.63	8.66±0.51
	Cookies	8.83±0.40	8.83 ±0.40	8.66 ±0.51	8.66 ±0.51	8.33 ±0.81	7.83 ±0.40	8.16 ±0.40	8.33±0.81	8.33±0.40
	Chidwa Laddu	8.66±0.51	8.50 ±0.54	8.66 ±0.51	8.50 ±0.54	8.33 ±0.51	7.66 ±0.51	8.50 ±0.83	8.00±0.00	8.16±0.40
	Omapodi	8.50±0.54	8.50 ±0.54	8.33 ±1.03	7.83 ±0.75	7.50 ±0.54	8.00 ±0.89	8.16 ±0.75	7.66±0.51	8.33±0.51
Middle Income	Dalia Porridge	8.46±0.51	8.40 ±0.50	8.60 ±0.73	8.46 ±0.63	8.26 ±0.70	7.73 ±0.45	8.20 ±0.67	8.00±0.75	8.33±0.61
	Chappathi	8.66±0.48	8.53 ±0.51	8.40 ±0.63	8.26 ±0.59	8.13 ±0.63	8.06 ±0.79	8.06 ±0.59	8.00±0.65	8.40±0.50
	Cookies	8.66±0.48	8.53 ±0.51	8.60 ±0.50	8.40 ±0.50	8.26 ±0.59	8.13 ±0.83	8.20 ±0.67	8.26±0.70	8.53±0.51

	Chidwa Laddu	8.66±0.48	8.66 ±0.48	8.53 ±0.63	8.33 ±0.48	8.06 ±0.25	8.13 ±0.83	8.13 ±0.83	8.20±0.56	8.40±0.50
	Omapodi	8.73±0.59	8.60 ±0.63	8.33 ±0.48	8.06 ±0.59	8.00 ±0.65	7.80 ±0.77	7.80 ±0.86	7.93±0.70	8.20±0.56
High Income	Dalia Porridge	9.00±0.00	9.00 ±0.00	8.50 ±0.53	8.25 ±0.70	8.50 ±0.75	8.25 ±0.46	8.12 ±0.83	8.12±0.64	8.87±0.35
	Chappathi	8.87±0.35	8.75 ±0.46	8.50 ±0.75	8.37 ±0.74	8.37 ±0.51	7.62 ±0.74	8.12 ±0.64	7.87±0.64	8.50±0.53
	Cookies	8.50±0.75	8.62 ±0.51	8.50 ±0.53	8.37 ±0.51	8.12 ±0.64	7.75 ±0.46	8.37 ±0.74	7.75±0.70	8.50±0.53
	Chidwa Laddu	8.75±0.46	8.75 ±0.46	8.12 ±0.64	8.25 ±0.86	8.12 ±0.83	7.50 ±0.75	8.25 ±0.46	8.00±0.92	8.50±0.53
	Omapodi	8.62±0.51	8.87 ±0.35	8.25 ±0.46	8.12 ±0.64	8.00 ±0.53	7.87 ±0.83	8.12 ±0.35	8.00±0.92	8.50±0.53

Consumer Attitudes towards Linseed Products

The consumer attitudes towards linseed products are discussed as follows

Consumer Attitude about Quality and Healthiness of Linseed

The consumer attitude about quality and healthiness of linseed is given in table-5.

Table 5: Consumer Attitudes about Quality and Healthiness of linseed

Statements	DS	D	DSW	ASW	A	AS
Linseed is healthy as it rich in omega 3 fatty acids	11.4	11.4	5.70	17.2	25.7	28.6
The hygiene aspect of linseed concerns me	8.60	8.60	17.2	22.8	22.8	20.0
I am concerned that linseed may cause vomiting	5.70	8.60	11.4	14.3	40.0	20.0
I would not let children eat linseed as I would worry about their health	17.2	11.4	25.6	17.2	11.4	17.2
Linseed is only fit for cattle food not human consumption	22.9	5.70	11.4	17.2	20.0	22.8

DS: Disagree Strongly, D: Disagree, DSW: Disagree Somewhat, ASW: Agree Somewhat, A: Agree, AS: Agree Strongly

Results on the response regarding the consumer attitude about quality and healthiness of linseed among the selected consumers revealed that 28.6 percent of them agree strongly that linseed are rich source of omega 3 fatty acids, 40 percent of them agree that linseed may cause vomiting. Around 25.6 percent of them disagree somewhat that they would not let their children eat linseed as I would worry about their health

and 22.9 percent of them disagree strongly that linseed is only fit for cattle food not human consumption.

Consumer Attitude about Linseed and its Attributes

The consumer attitude about linseed and its attributes is given in table-6

Table 6: Consumer Attitude linseed and its Attributes

Statements	DS	D	DSW	ASW	A	AS
I worry that linseed is too oily	5.7	8.6	17.2	17.2	22.8	28.5
I am not confident that I could cook linseed	17.2	11.4	14.3	14.3	14.3	28.5
I worry that linseed is too sticky	5.7	17.2	25.7	25.7	14.3	11.4
I do like the look of linseed	34.2	8.6	17.2	17.2	11.4	11.4

DS: Disagree Strongly, D: Disagree, DSW: Disagree Somewhat, ASW: Agree Somewhat, A: Agree, AS: Agree Strongly

Results on the response regarding the consumer attitude about linseed and its attributes among the selected consumers revealed that 28.5 percent of them agree strongly hat linseed is too oily, 28.5 percent of them agree strongly that they are not confident that they could cook linseed. Around 34.2 percent of them disagree strongly that they do like that they look of linseed.

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