International Food Research Journal 16: 483-492 (2009)

Sensory descriptive analysis and consumer acceptability of original "kaya" and "kaya" partially substituted with inulin

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Abstract: A study was done on the feasibility of inulin, a fructooligosaccharides with the health benefits of prebiotic, as partial sugar replacer in "kaya" by investigating the effects of different substitution levels (0%; control, 10%, 30% and 50%) on the sensory properties. The samples were investigated by 10 descriptive panelists for colour, sweetness, smoothness, firmness, adhesiveness and spreadability attributes before further evaluated by 100 consumers for acceptance levels. Consistent with the descriptive panel, the evaluation by the consumers showed formulated samples at 10% and 30% were comparable to the commercial "kaya" being no significant difference ($p>0.05$) found in acceptability scores. 50% substitution received lower acceptability scores and was significantly different ($p<0.05$) from the rest. Overall, this study clearly underlines that it is possible to substitute sugar by inulin in "kaya" formulation in amount of at least up to 30% to achieve the health benefits of inulin and sugar reduction, without imposing a negative impact on sensory perception and consumer liking.

Keywords: sensory analysis, consumer preference, sugar replacer, "kaya", inulin

Introduction

A published article which studied on breakfast practices in Asian region found bread or toast with "kaya" was among the most common at-home breakfast for Malaysian (Howden *et al.,* 1993). "Kaya", a popular local spread with jam-like consistency, is prepared by processing egg, sugar and coconut milk and may contain edible starch, yet at inconsistent ratios, to yield a concentrated semi-solid final product (Ragab, 1971; Legal Research Board, 2005). In terms of food chemistry, "kaya" is the water-in-oil emulsion distributed in a matrix of fine particles of protein and soluble solids (Ragab, 1971). Most table spread, including "kaya" are high in fat and sugar, hence calories. Although a number of studies (Gills and Resurreccion, 2000; Gajar and Badrie, 2001; Mckee *et al.,* 2002; Yeh *et al.,* 2002, 2003; Kim *et al.,* 2005; Dalton *et al.,* 2006) have been conducted to develop healthier spread choices such as peanut butter, margarine, butter and fruit jam, availability of literature on development of healthier "kaya" was limited.

The estimated average daily consumption of sugar among Malaysians is 250 g; a figure which is appreciably higher than the recommended intake of 50 gram/day (g/d) (NCCFN, 2005; Ministry of Health Malaysia, 2006). Based on the Food Balance Sheet data for Malaysia, the availability of sugar for the population was estimated to be about 86 g/d in 1985 and this amount was later found to have increased to 104 g/d in 2002 (NCCFN, 2005). Inulin is being proposed to partially replace sugar in "kaya" in this study. This food ingredient is a naturally occurring fructooligosaccharides composed from fructose monomers (Niness, 1999; El-Nagar *et al.,* 2002; Pool-Zobel *et al*., 2002). At the dosage level around 2-30%, inulin has been incorporated successfully as sugar replacer in dairy products, frozen desserts, baked goods and breads, fillings, fruit preparations, chocolate and diabetic products (Franck, 2002). Nutritional benefits of inulin include its dietary fiber effect, prebiotic effect and low caloric value (1.5 kcal/g) (Roberfroid, 1999, 2005).

Therefore, it was the objective of this study to investigate the different levels of sugar replacement by inulin on the sensory properties of "kaya".

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Materials and Methods

Preparation of control "kaya"

"Kaya" was prepared following a modified procedure described by Beh (2004) and Anita (2004). Table 1 shows the mix formulation: 50% weight/weight (w/w) coconut milk (Ayam Brand UHT Coconut Milk), 22% (w/w) medium size eggs (Seri Murni, FFM Farms Sdn. Bhd., Malaysia), and 28% (w/w) sweetener. The sweetener portion comprised of differing percentages of fine granulated sugar (Prai, Malayan Sugar MFG, Malaysia) and inulin (Frutafit® IQ, the instantised version of powdered inulin manufactured by Sensus Inc., The Netherlands). A Control (C) and three formulation trials, denoted F1 (90% sucrose/10% inulin), F2 (70% sucrose/30% inulin) and F3 (50% sucrose/50% inulin) were developed.

Based on percentages in Table 1, the amount of raw materials used would be expressed in gram to facilitate subsequent description. Control "kaya" was prepared by adding sequentially 330 ± 1 g beaten egg, 750 ± 1 ml coconut milk and 360 ± 1 g sugar (Portion A) while continuously stirred with a wooden spatula. The manual stirring process took about 5-10 minutes to completely dissolve the sugar and to uniformly distribute the mass. The mixture was then cooked in double-boiler with the heating medium (water) at 60°C as the starting temperature. The water, which was the heating medium to cook the "kaya", was heated using induction cooker (Jusco Selection) throughout the "kaya" processing and that this water level shall be maintained at least up to the level of the mixture inside the container. Double boiler heating is more suitable over direct heating as it gives a considerably slow heating effect and reduces burning risk as the cooking process took several hours, depending on the quantity of raw materials used. As temperature rose during the duration, the mixture thickens and the initial creamy egg-white colour slowly turned into pale brown. Mixtures were held at for approximately 3 hours with constant stirring at a temperature not exceeding 90°C to avoid partial coagulation of egg protein (Ragab, 1971). Continuous stirring was important throughout the cooking process to distribute the heat evenly, or otherwise, the localized heat (at the edge and bottom) of the pot would result in egg proteins coagulation.

The progress of cooking was monitored via refractometer. When the mixture reached 51±1° Brix, 60 ± 1 g sugar (Portion B) was heated separately using a non-stick pan until all the sugar melted and turned brown, which took less than 5 minutes. The resultant caramel was subsequently added into the mixture to obtain an appealing golden brown colour. The mixture, now became "kaya", was stirred until the colour blended evenly. Cooking was continued until the concentration reached 57 ± 1 ° Brix in order to achieve the consistency necessary for spreadability. Hence, as the Brix reached 57°, the "kaya" was promptly hot-filled into pre-sterilized jam glass jars (500 ml), leaving a headspace of approximately 1-2 cm before sealing with fitted covers. After the "kaya" was cooled to room temperature, it was chill stored at 6°C. The "kaya" was warmed to 25°C before each sensory evaluation.

Preparations of samples with inulin

Using a similar procedure, "kaya" substituted with inulin was produced by replacing the total sugar (Portion A + B) used. The quantity of inulin vs. sugar used was F1 (Inulin 42 g; Sugar (Portion A) 318 g; Sugar (Portion B) 60 g), F2 (Inulin 126 g; Sugar (Portion A) 234 g; Sugar (Portion B) 60g), and F3 (Inulin 210 g; Sugar (Portion A) 150 g; Sugar (Portion B) 60 g). The amount of Portion B sugar was kept constant in order to minimize colour variation. Mixed with Portion A sugar, inulin was added after

Table 1. Experimental designs (percentage by weight)[a]

Ingredients	(C)[a]	Treatment[b]		
		(F1)	(F2)	(F3)
Coconut milk	50	50	50	50
Egg (medium size)	22	22	22	22
Sugar as sweetener (Portion A)	24	21.2	15.6	10
Sugar for preparation of caramel colour (Portion B)	4.0	4.0	4.0	4.0
Inulin	-	2.8	8.4	14
Total	100	100	100	100

[a]adapted from Beh (2004)

[b] F1: 90% sucrose/10% inulin; F2: 70% sucrose/30% inulin; F3: 50% sucrose/50 % inulin

Table 2. Terms used in descriptive analysis of "kaya" spread

Attribute[a]	Definition and method for evaluation
Appearance	Take off lid from the container and look at the sample[b]
Brown colour[b,c,d]	The intensity of brownness from light to dark brown
Tastes	Place 1/4 tsp of a sample in the mouth and evaluate for taste[b]
Sweetness[b,c,d]	The taste on the tongue associated with sucrose solution
Oral Texture	Place 1/4 tsp of a sample in the mouth and compress between the tongue and palate[b]
Adhesiveness[b,c,d]	The degree of the sample sticks to the palate /
Firmness[b,d]	The force to compress a sample via first compression
Physical Test	Use a knife to spread a sample (5 g) onto one piece of (2 x 3 inches) bread[b]
Spreadability[b]	Ease of spreading of sample on bread

[a] The attribute listed in order as perceived by the panelists
[b] Chu and Resurreccion (2005)
[c] Yeh *et al*. (2002)
[d] Meilgaard *et al*. (1999)

the coconut milk. The mass was stirred for additional 10-25 minutes; depending on the percentage of replacement. Generally, the dissolution time increases with inulin concentration. When the dry ingredients observed to have dissolved, the mixture was cooked using double boiler.

From the initial mass of 1.5 kg for each formulation (C, F1, F2 and F3), procedures above yielded cooked "kaya" with net weight of approximately 1 kg, filling about 4 bottles of 250 ml glass jars. Cooking for all the formulations was stopped upon reaching 57° Brix in order to standardize the procedures as well as the soluble solids content.

Quantitative Descriptive Analysis (QDA)

Prospective members of the descriptive panel were recruited among a pool of undergraduates and staff from the Faculty of Applied Sciences in UCSI University. Prescreening questionnaires (Meilgaard *et al*., 1999) were distributed to them prior to the screening process. Prospective panelists were then subjected to a series of screening tests (Meilgaard *et al*., 1999).

Ten screened panelists (3 males, 7 females, with average age 22.25 ± 1.48 years) were selected to proceed for the training phase. The panelists were trained on QDA techniques in five 2-hours training sessions for a total of 10 hours. During the first training session, an overview of QDA was given. This was followed by terminology development in which the panelists were asked to develop a list of terms (descriptors) describing the sensory attributes of "kaya" using the presented commercial samples (Lawless and Heymann, 1999; Ruzaina *et al*., 2006). After a group discussion, a consensus was reached and six key attributes with their respective definitions (Table 2) were selected for evaluation. The reference standards (Table 3) to be used for each attribute were determined.

In the next two training sessions, panelists were familiarized with the evaluation techniques and provided with written and verbal descriptions of how to rate intensity of the sensory attributes using 150-mm unstructured line scales with anchor points at 12.5 mm from each end (Schaller-Povolny and Smith, 1999; Kim *et al*., 2005). The anchors were: brown colour (white to brown), sweetness intensity (none to strong), smoothness (rough to smooth), firmness (soft to firm), adhesiveness (not sticky to very sticky) and spreadability (least spreadable to most spreadable). For the remaining of the training sessions, after the panelists were familiar in using the scale with reference standards, they were exposed to an informal pretest where a "kaya" sample was served for evaluation along with reference standards. The means and standard deviations of the panel were calculated for each attribute and were presented to the panelists. The attributes were highlighted to indicate whether or not their individual ratings were within ±10% of the group mean. The panelists were made aware of which attributes they needed to work on, and this procedure also helped calibrate the panel.

The samples were prepared within four days prior to the first evaluation day and stored in the

Table 3. Standard references and intensities used in descriptive analysis of "kaya" spreads

Sensory attribute	Reference	Brand/Type/Manufacturer	Intensity[a] (mm)
Appearance			
Brown colour	White paper[b]	Georgia–Pacific (Georgia–Pacific Corp., Atlanta, GA)	0
	Peanut butter[b]	JIF (J.M. Smucker Co., Orrville, OH)	35
	Chocolate syrup[b]	Hershey (Hershey Foods Corp., Hershey, PA)	150
Tastes			
Sweetness	2.0% sucrose solution[d]	Prai fine granulated sugar (Malayan Sugar MFG, Malaysia)	20
	10.0% sucrose solution[d]	Prai fine granulated sugar (Malayan Sugar MFG, Malaysia)	100
	16.0% sucrose solution[d]	Prai fine granulated sugar (Malayan Sugar MFG, Malaysia)	150
Oral Texture			
Adhesiveness	Philadelphia cream cheese [c]	Kraft Foods, Glenview, Ill., U.S.A.	45
	Peanut butter[b]	JIF (J.M. Smucker Co., Orrville, OH).	135
Firmness	Aerosol whipped cream[e]	Redi-Whip	4.9
	Cheese Whiz[d,e]	Kraft	45
	Cream cheese[d,e]	Kraft/Philadelphia	120
Smoothness	Margarine[e]	Daisy Soft (Lam Soon Edible Oils Sdn. Bhd.)	31
	Cheese Whiz[e]	Kraft	121
	Mashed potato[e]	Washed potatoes (imported from Germany)	144
Physical Test			
Spreadability	Peanut butter[b]	JIF (J.M. Smucker Co., Orrville, OH)	75
	Cream cheese[b]	Kraft Philadelphia Light (Kraft Foods North America, Glenview)	95
	Mayonnaise[b]	Kraft (Kraft Foods North America, Glenview, IL)	145

[a] The intensity ratings are based on 150-mm unstructured line scales
[b] Chu *et al*. (2005), [c] Yeh *et al*. (2002), [d] Meilgaard *et al*. (1999)
[e] references and intensities were determined by panelists through consensus ratings after discussion

fridge at about 6°C. Prior to the testing, one hour was spent in calibration of panelists in which the Control was presented to each panelist as warm-up sample to increase reliability of attribute intensity ratings (Plemmons and Resurreccion, 1998). For actual testing, 5 g of each sample was prepared in 1-oz cups with lids to evaluate spreadability, and 15 g of each sample was prepared in 2-oz cups with lids to evaluate the five other attributes. Samples were coded with 3-digit random numbers and served at room temperature using balanced-block design for a four-product test with replications. During product testing, reference standards along with the warm-up sample (with the average ratings) were available to panelists. They could either swallow or expectorate the samples. To reduce carry-over effect, panelists were instructed to cleanse their palates by chewing a small piece of unsalted crackers and rinsing with water between samples. Ten trained descriptive panelists rated each attribute for each treatment for a total of 3 times in 3 different days.

Consumer testing

A hundred (100) untrained consumers were randomly chosen among the students and staff at UCSI to participate. All participants were 18 years of age or older. To determine how well a new product is liked by consumers, it was compared to a well-liked commercial product (Meilgaard et al., 1999). For this reason, commercial "kaya" was used in this test. A total of 4 samples (commercial sample, F1, F2 and F3) were presented simultaneously for evaluation. The sample of approximately 10 g was placed in lidded transparent small cups, which were accompanied with white bread (onto which the product was spread by the panelists) and room temperature water for

palate cleansing purposes between sample tasting. Differ from QDA, the panelists for this test is given a carrier (bread) as the consumers often take "kaya" with bread. Consumers were also presented with a questionnaire and instructions on proper filling (Meilgaard et al., 1999; Pavon, 2003). Consumers rated appearance, odor/aroma, spreadability, taste, mouthfeel, and overall liking of the product based on the 9-point hedonic scale (1= dislike extremely, 5 = neither like nor dislike, 9= like extremely). Purchase intent for consumers was evaluated using a binomial (yes/no) scale (Pavon, 2003). Panelists were also instructed to report any descriptors for their observations of the sensory characteristic for the "kaya" samples.

Statistical analysis

Data analysis was conducted using Minitab 15 software (Minitab Inc., USA). The data was statistically tested using analysis of variance (one-way ANOVA) to determine if statistical difference ($p<0.05$) existed, and followed by Tukey's test to identify statistical differences among the means. Triplicate measurements were taken for each analysis. Results from all the tests were expressed as means ± standard deviations (SD).

Results and Discussion

Quantitative Descriptive Analysis

Mean intensity ratings of descriptive attributes are tabulated in Table 4 and profiled in Figure 1. Results showed that there were significant differences ($p<0.05$) within at least two samples for all the 6 attributes tested. It was assumed that the differences were raised from the variations in inulin substitution percentages, as all samples were produced under the similar controllable conditions.

The observed colour changes to pale brownish during "kaya" processing is potentially due to Maillard reaction, a non-enzymatic browning reaction between amino acid and reducing sugar under heat treatment. Caramel colour, the amorphous dark brown substances resulting from the carefully controlled heat treatment of sugars (Ragab, 1971), is the most common colour utilized in "kaya" production to bring the final products to the acceptable level of brown intensity. Colour, however, was an uncontrollable factor in this study as consistency was hard to achieve despite the fact that equal amount of sugar was used for caramelization each time. Since the colour of sugar of caramelization was found difficult to be controlled via direct heating method (frying)

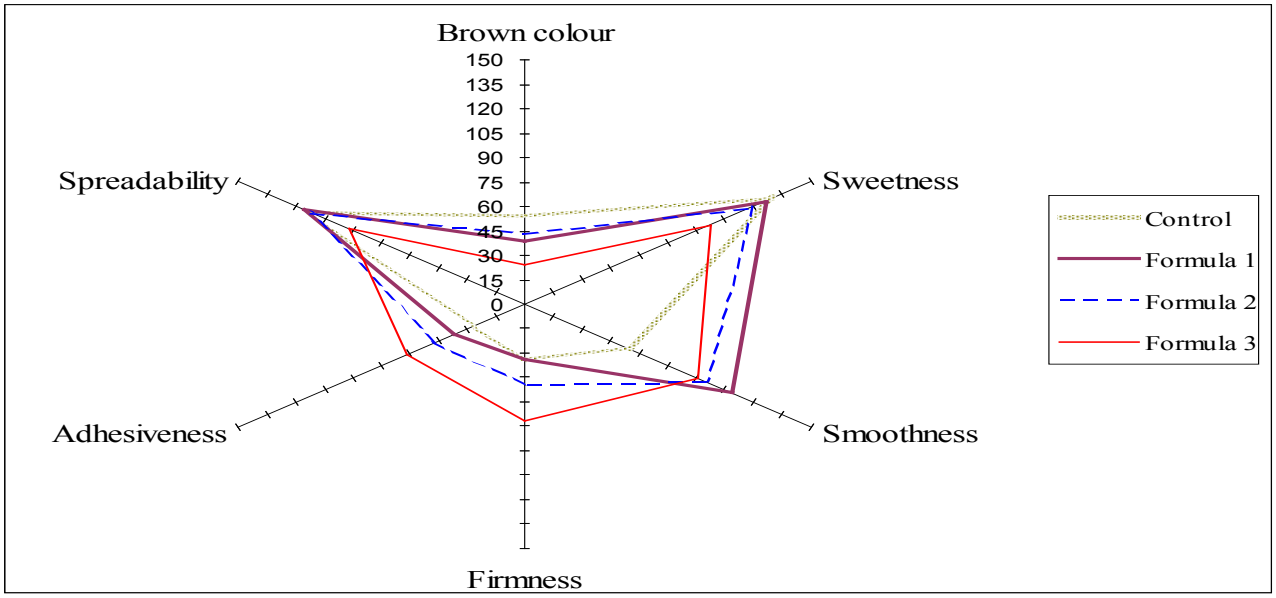

Figure 1. Spider diagram of the mean intensity ratings for the sensory attributes of the formulated "kaya" samples
* Each spoke of the diagram represents an individual sensory attribute. The intensity scales each go from lower values at the center point to higher values at the outer end of the spoke. The intensity of an attribute in a specific product is represented by the point on the spoke at which the connecting line for that product cross

Table 4. Mean intensity ratings for the formulated "kaya" samples[1]

Attributes	Sample[2]			
	Control	Formula 1	Formula 2	Formula 3
Brown colour	53.87 ± 18.68a	38.40 ± 11.77b	43.83 ± 12.59ab	24.37 ± 11.10c
Sweetness	129.43 ± 14.67a	125.67 ± 15.10a	118.30 ± 17.10a	96.50 ± 23.67b
Smoothness	53.03 ± 19.14c	108.33 ± 18.06a	94.77 ± 20.34ab	90.73 ± 21.96b
Firmness	33.90 ± 14.50c	33.90 ± 13.04c	49.23 ± 17.81b	71.40 ± 19.58a
Adhesiveness	25.67 ± 16.41c	36.97 ± 14.87bc	46.30 ± 19.94b	62.07 ± 28.45a
Spreadability	111.73 ± 15.24a	115.00 ± 11.61a	111.83 ± 10.36a	92.40 ± 12.57b

[1] Values represent means ± standard deviation; n =30
Ratings are based on a 150 mm line scale with anchors. 10 trained descriptive panelists rated each attribute for each treatment for a total of 3 times in 3 different days
[2] Control - 100% sucrose; Formula 1 - 90% sucrose/ 10% inulin; Formula 2 - 70% sucrose/ 30% inulin; Formula 3 - 50% sucrose/ 50 % inulin
a-c Different letters in same row indicate a significance difference at $p < 0.05$

as it occurs too rapidly, a solution suggested is for sugar be heated together with water (sugar to water ratio is 1:1) so that caramelization may occur slower and hence could have better control over the colour development (Faridah and Mohd Mohid, 1997). Based on the work by Shu (1998), it was assumed that inulin would not participate in Maillard reactions and hence would not contribute to colour due to the reaction. Inulin would not impart effect on the colour of the samples as it neither involved in Maillard reaction nor caramelization.

Previous studies which utilized inulin as substitution for the conventional sweetener in food products such as ice-cream and chocolate had demonstrated that sweetness level would be decreased with substantial amount of inulin replacement (Schaller-Povolny and Smith, 1999; Golob *et al*., 2004). This is as expected since Frutafit® IQ produces only 10% sweetness level of sucrose (Sensus, 2007). The less sweetening power of inulin is perhaps due to the longer chain lengths of the molecules (Schaller-Povolny and Smith, 1999). Panelists, however, found no significant differences ($p>0.05$) in the sweetness of the "kaya" samples tested, except for the "kaya" replaced with 50% inulin in which it received significantly different ($p<0.05$) scores. This result may indicate that the panelists were not sensitive enough to highlight the differences up to at least 30% inulin substitution. These results confirms the concept of Bolenz *et al.* (2006): "where at high overall sweetness level, it is difficult, even for trained panelists, to distinguish between varying sugar concentrations".

Besides that, addition of inulin was also found to affect the oral textural attributes (smoothness, firmness, and adhesiveness) of the "kaya" samples, which may be partly explained by the effect of inulin gel formation (Kim and Wang, 2001). In term of smoothness, inulin substitution exhibited significant effect ($p<0.05$) on all the formulations. "kaya" samples with inulin substitution exhibited higher rating compared to Control sample. Inulin gels are generally described to be particle gels composed of a tri-dimensional network of insoluble sub-micron crystalline particles (Franck, 2002). These particles are not discretely perceptible in the mouth; instead they interact to impart a smooth and creamy structure (Niness, 1999; Franck, 2002), which may explain the increased ratings for smoothness.

Substitution of inulin for sugar had a significant effect ($p<0.05$) on the firmness of "kaya" samples except for F1 sample. Overall, it increased the firmness (hardness) of the "kaya". Similar trends were evident in other products as well, including yog-ice cream (El-Nagar *et al*., 2002), bologna-type sausages (Nowak *et al*., 2007 and "dadih" (Ruzaina *et al*., 2006). Brennan and Tudorica (2007) postulated that inulin was able to form gel-like structures alongside the casein matrix in yogurt system, which strengthen the overall food structure and may explained the increased firmness and consistency. In agreement, El-Nagar *et al*. (2002) proposed that the increasing hardness in yog-ice-cream was related to (1) reduction of sugar content, and (2) improved consistency of the mix due to the gelling properties of inulin. Additionally, hardness was also found to positively related to inulin concentration. Gel strength was found to be a strong function of inulin concentration (Kim *et al*., 2001; Chiavaro *et al*., 2007). Therefore, it was suggested that the increased of firmness with percentage of inulin substitution in the "kaya" samples is due to the increased gel strength.

Lima *et al*. (2000) described adhesiveness (or stickiness) as 'the work required to overcome the attractive forces between the food surface and the surface of other material which comes into contact with the food such as the palate, tongue and teeth'. Increasing adhesiveness ratings for "kaya" samples were observed with the amount of inulin addition These observations are consistent with those of El-Nagar *et al*. (2002), Golob *et al*. (2004) and Nowak *et al*. (2007). El-Nagar *et al*. (2002) reported that the increased of adhesiveness observed within inulin enriched samples could be due to the formation of viscous inulin gel matrix. Inulin gel was reported as being adhesive and its adhesiveness was found to increase with inulin concentration, processing temperature, and the chain length of inulin molecules (Chiavaro *et al*., 2007). F3 showed a significant effect ($p<0.05$) on adhesiveness rating where it was higher than F1 and F2, most likely due to the higher inulin concentration that results in formation of larger entangled gel network (Chiavaro *et al*., 2007). In addition, these sticky substances may adhere to the lips and tongue, and also pack on the crowns of the consumer's teeth (Silver *et al*., 2003). Hence, the increased adhesiveness would be undesirable in the spread products (Lima and Guraya, 2005).

Panelists found Control, F1 and F2 to have similar spreadability level as no significant difference ($p>0.05$) was detected among each other. On the other hand, substitution of inulin at 50% (F3) was found to have a significant effect ($p<0.05$) on the spreadability. The lower ratings for F3 may be related to its highest sensory scores for firmness and adhesiveness attributes, which reduced the ease of spreading the sample over the breads. Indeed, it has been reported that the hardness (firmness) is inversely correlated with the spreadability in other types of spreads as well, such as butter, margarine, and peanut butter (Yeh *et al*., 2003; Kim *et al*., 2005; Lima and Guraya, 2005). Low values of hardness represent greater fluidity or reduced toughness, and thus, improved the spreadability of the spread and vice versa (Lima *et al*., 2000; Lima and Guraya, 2005).

In general, high ratings for smoothness, spreadability and sweetness are considered as positive effects that would be favoured by consumers while increased in firmness and adhesiveness are regarded as undesirable. Based on Figure 1, F3 was described as sticky, firm, least sweet and least spreadable; while F1 and F2 were perceived more positively (softer, sweeter, less sticky and better spreadability).

Consumer tests

Mean consumer ratings of "liking" for appearance, aroma, spreadability, flavour, texture and overall acceptability are presented in Table 5. All the attributes evaluated showed significant differences ($p<0.05$) between commercial "kaya" and formulated "kaya" samples.

Overall, consumers liked commercial sample the best; F1 and F2 were rated slightly lower for overall acceptability, but not significantly different ($p>0.05$) from the commercial sample. The commercial sample and F1 received ratings higher than 6 ("like slightly") for all the attributes, implying that the products are well-liked by the consumers (untrained panelists). In term of preference for spreadability, flavour and texture, there was no significance difference ($p>0.05$) between commercial sample and F2. Most of the consumers gave good ratings for F2 but commented

Table 5. Mean of hedonic ratings for consumer's acceptance of formulated "kaya" samples[1]

Attributes	Sample[2]			
	Commercial	Formula 1	Formula 2	Formula 3
Appearance	6.45 ± 1.55a	6.53 ± 1.44a	5.28 ± 1.81b	4.66 ± 1.73b
Aroma	6.97 ± 1.23a	6.06 ± 1.29b	5.80 ± 1.43bc	5.38 ± 1.60c
Spreadability	6.84 ± 1.47a	6.87 ± 1.38a	6.67 ± 1.41a	4.99 ± 1.78b
Flavour	6.71 ± 1.52a	6.01 ± 1.74b	6.39 ± 1.55ab	4.97 ± 1.92c
Texture	6.22 ± 1.52a	6.54 ± 1.48a	6.70 ± 1.35a	4.56 ± 1.95b
Overall acceptability	6.68 ± 1.41a	6.39 ± 1.48a	6.39 ± 1.44a	4.82 ± 1.81b

[1]Values represent means ± standard deviation; n = 100
Hedonic ratings based on 9-point hedonic scales with the descriptors: 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, and 1 = dislike extremely.
[2]Commercial sample – 'Auntie Rosie Original Homestyle Kaya'; Formula 1 - 90% sucrose/ 10% inulin; Formula 2 - 70% sucrose/ 30% inulin; Formula 3 – 50% sucrose/ 50 % inulin
a-c Different letters in same row indicate a significance difference ($p < 0.05$)

Table 6. Purchase intent responses (%) for formulated "kaya" samples

Sample[1]	Purchase Intent		Purchase Intent Product With Reduced Sugar[2]		Purchase Intent with knowledge of Health benefits[2]	
	Yes	No	Yes	No	Yes	No
F1	68	32	85	15	89	11
F2	61	39	81	19	90	10
F3	19	81	63	37	74	26

[1] F1 - 90% sucrose/ 10% inulin; F2 - 70% sucrose/ 30% inulin; F3 - 50% sucrose/ 50 % inulin
[2] Consumers were asked about their purchase decision if the product was reduced sugar and with knowledge of the potential health benefits from the consumption of a product containing inulin

that F2 need further improvement in aroma and colour. Although the appearance and aroma ratings of F2 were lower than commercial sample, future work to improve the acceptance is possible. The substitution of sugar content with inulin for 50% has been reported successful in chocolate making (Golob *et al*., 2004). In this research, however, F3 (substitution at 50%) was rated lowest (below 6) for all the studied attributes. F3 was least preferred by consumers, perhaps due to the existence of significant differences compared to the conventional product. Substitution at 50% significantly reduced the sweetness and spreadability while increased the firmness and adhesiveness. Although there were some consumers who liked these new differences and rated the sample high, majority would not accept a product that was different from the conventional. In addition to the significant differences, the increased in the undesirable textural attributes (firm and sticky) may also reduce the overall acceptability. As reported by Devereux *et al*. (2003), texture is an important attribute of food quality, where the lower rating of the texture diminished the overall acceptability. In QDA, overall acceptability was not included as one of the attributes; the reason being is that QDA panelists should be as objective as possible and hence should not be subjected to preference judgments (Lawless and Heymann, 1999; Gills and Resurreccion, 2000)

Purchase Intent

Purchase intent of a reduced sugar product, and purchase intent with knowledge of the health benefits provided by inulin for the three formulated samples (F1, F2 and F3) were evaluated based on a binomial (yes/no) scale. The results were presented in Table 6. Purchase intent results agreed with those for product acceptability. F1 and F2, both with overall acceptability higher than 6.0, received much higher number of positive responses (>60%) compared to F3 (<20%). When consumers were asked of their intent of purchasing a reduced sugar product, responses given changed from the initial intent. Purchase intent for all the formulations increased, meaning that consumers were willing to sacrifice overall liking of the product for its reduced sugar characteristic. Similarly, the responses also changed when the consumers were questioned about their intent to purchase a product once they were informed of the potential health benefits associated with the consumption of inulin. Purchase intent was highest for F2, followed by F1 and F3, with 90%, 89%, and 74%, respectively. Although more than half (59%) of the consumers who participated in this consumer test initially were not aware about the health benefits of inulin, the purchase intent increased remarkably once they were informed about it. This suggests that "kaya" formulated with inulin holds a good marketability prospects seeing that the consumers were willing to purchase "kaya" that contained inulin as a health-promoting ingredient.

Conclusion

Addition of inulin was found to have significant effect ($p<0.05$) on smoothness, firmness and adhesiveness on the "kaya" samples, possibly due to the formation of inulin gel in the food system. Nonetheless, no significant difference ($p>0.05$) was found between F1 and Control for the attributes aforementioned except for smoothness, suggesting that substitution at 10% is unlikely to result in gel formation. The hedonic results generally are coherent with results drawn from QDA. The acceptance levels for F1 and F2 were comparable to the commercially available "kaya" in the market. Hence, it could be

concluded that substitution of inulin in amount up to 30% in "kaya" making could produce an acceptable product with a marketability potential. Substitution at 50% and higher, however, is not recommended as it would most probably affect the sensory attributes significantly, which may not be well-liked by consumers on the whole.

Acknowledgement

The authors wish to express their sincere gratitude to UCSI for funding this research.

References

Internet: Anita, 2004. Homemade "kaya" - Pandan Flavour. Jo's Deli Bakery. Downloaded from http://jodelibakery.netfirms.com/SAE/homemade%20"kaya"-pandan/homemade_"kaya"_pandan.htm on 20/6/2007.

Internet :Beh, A., 2004. Homemade "kaya": Recipe by Amy Beh. Downloaded from http://kuali.com/recipes/viewrecipe.asp?r=2137 on 1/6/ 2007.

Brennan, C. S., and Tudorica, C. M. 2007. Carbohydrate-based fat replacers in the modification of the rheological, textural and sensory quality of yoghurt: comparative study of the utilisation of barley beta-glucan, guar gum and inulin. International Journal of Food Science and Technology xx: 1-10.

Bolenz, S., Amtsberg, K., and Schape, R., 2006. The broader usage of sugars and fillers in milk chocolate made possible by the new EC cocoa directive. International Journal of Food Science and Technology 41: 45–55.

Chiavaro, E., Vittadini, E., and Corradini, C. 2007. Physicochemical characterization and stability of inulin gels. European Food Research Technology 225: 85–94.

Chu, C.A. and Resurreccion, A.V.A. 2005. Sensory profiling and characterization of chocolate peanut spread using response surface methodology. Journal of Sensory Studies 20: 243–274.

Dalton, A., Wittuhn, R. C., Smuts, C.M., Wolmarans, P. and Nel, D.G. 2006. Development, microbiological content and sensory analysis of a spread rich in n-3 fatty acids. Food Research International 39: 559–567.

Devereux, H.M., Jones, G.P., McCormack, L. and Hunter, W.C. 2003. Consumer acceptability of low fat foods containing inulin and oligofructose. Journal of Food Science 68 (5): 1850-1854.

El-Nagar, G., Clowes, G., Tudorica, C. M., Kuri, V. and Brennan, C. S. 2002. Rheological quality and stability of yog-ice cream with added inulin. International Journal of Dairy Technology 55 (2): 89-93

Faridah, A. A. and Mohd. Mohid, H. 1997. Kawalan mutu pemprosesan seri "kaya". Teknologi Makanan 16 (1): 49-56.

Franck, A. 2002. Technological functionality of inulin and oligofructose. British Journal of Nutrition 87 Suppl. 2: S287–S291.

Gajar, A-M., & Badrie, N. 2001. Processing and quality evaluation of a low-calorie Christophene jam (*Sechium edule* (Jacq.) Swartz. Journal of Food Science 67(1): 341–346.

Gills, A. and Resurrecion, A.V.A. 2000. Overall acceptability and sensory profiles of unstabilized peanut butter and peanut butter stabilized with palm oil. Journal of Food Processing Preservation 24: 495-516.

Golob, T., Micovic, E., Bertoncelj, J, and Jamnik, M. 2004. Sensory acceptability of chocolate with inulin. Acta Agriculturae Slovenica 83 (2): 221 – 231

Howden, J. A., Chong, Y. H., Leung, S. F., Rabuco L. B., Sakamoto, M., Tchai, B. S., Tontisirin, K., Wahlqvist, M. L., Winarno, F.G. and Yap, M. 1993. Breakfast practices in the Asian region. Asia Pacific Journal of Clinical Nutrition 2: 77-84.

Kim, B. H., Shewfelt, R. L., Lee, H. and Akoh, C.C. 2005. Sensory evaluation of butterfat-vegetable oil blend spread prepared with structured lipid containing canola oil and caprylic acid. Journal of Food Science 70 (7): S406-S412.

Kim, Y., Faqih, M. N. and Wang, S. S. 2001. Factors affecting gel formation of inulin. Carbohydrate Polymer 46: 135-145.

Kim, Y. and Wang, S. S. 2001. Kinetic study of thermally induced inulin gel. Journal of Food Science 66 (7): 991–997.

Lawless, H.T., and H. Heymann. 1999. *Sensory Evaluation of Food: Principles and Practices.* New York: Kluwer Academic/Plenum Publishers

Legal Research Board, as at 5th July 2005. *Food Act 1983 (Act 281) and Regulations*. Malaysia: International Lawbook Series

Lima, I. M., Guraya, H. S. and Champagne, E. T. 2000. Improved peanut flour for a reduced-fat peanut butter product. Journal of Food Science 65 (5): 854-861.

Lima, I. M. and Guraya, H. S. 2005. Optimization analysis of sunflower butter. Journal of Food Science 70 (6): S365-S370.

McKee, L.H., Garcia-Whitehead, C. and Remmenga, M. 2002. Quality characteristics of red raspberry fruit spread made with four sweeteners. Plant Foods for Human Nutrition 57: 343–352.

Meilgaard, M., Civille, G.V. and Carr, B.T. 1999. *Sensory Evaluation Techniques*. 3rd Ed. USA: CRC Press LLC.

Internet: Ministry of Health Malaysia. 2006. Soft Drinks to Have Less Sugar and Fast Food Less Fat. Downloaded from http://www.myhealth.gov.my on 19/10/2007.

National Coordinating Committee On Food and Nutrition (NCCFN), 2005. *RNI: Recommended Nutrient Intakes for Malaysia.* Putrajaya: Ministry of Health Malaysia.

Niness, K. R. 1999. Inulin and oligofructose: what are they? The Journal of Nutrition 129: 1402S–1406S.

Nowak, B., Von Mueffling, T., Grotheer, J., Klein, G. and Watkinson, B. M. 2007. Energy content, sensory properties and microbiological shelf life of German bologna-type sausages produced with citrate or phosphate and with inulin as fat replacer. Journal of Food Science 72 (9): S629 – 638.

Pavon, N. R. 2003. Sensory characteristics of flavored milk candies. Thesis. Louisiana State University. Baton Rouge. Louisiana.

Plemmons, L. E. and Resurreccion, A. V. A. 1998. A warm-up sample improves reliability of responses in descriptive analysis. Journal of Sensory Studies 13: 359-376.

Pool-Zobel, B., Loo, J. V., Rowland, I. and Roberfroid, M. B. 2002. Experimental evidences on the potential of prebiotic fructans to reduce the risk of colon cancer. British Journal of Nutrition 87 (2): S273–S281.

Ragab, M.H.H., 1971. *Canned "kaya" "A Coconut-based Product"*. Food technology Research and Development Center Malaysia Report No. 53

Roberfroid, M. B. 2005. Introducing inulin-type fructans. British Journal of Nutrition 93: S13–S25.

Roberfroid, M.B. 1999. Caloric value of inulin and oligofructose. The Journal of Nutrition 129: 1436S–1437S.

Ruzaina, I., Shuhaimi, M., Abdullah, S., Sharifah Kharidah, S. M. and Mohd Yazid, A.M. 2006. Influence of inulin addition on physical properties and sensory of 'dadih'. Journal of Applied Sciences 6 (5): 1128-1131.

Schaller-Povolny, L.A. and Smith, D.E. 1999. Sensory attributes and storage life of reduced fat ice cream as related to inulin content. Journal of Food Science 64 (3): 555 – 559.

Sensus Inc. 2007. Product Data Sheet: Frutafit® IQ

Shu, C. K. 1998. Flavor components generated from inulin. Journal of Agriculture and Food Chemistry 46: 1964 -1965.

Silver, B. S. 2003. Processes for making novel inulin products. US Patent 6,569,488.

Yeh, J. Y., Phillips, R. D. and Hung, Y.C. 2003. Optimizing protein- and vitamin-fortified peanut spreads containing soybean or milk powder. Journal of Food Quality 26: 243-256.

Yeh, J.Y., Resurreccion, A.V.A., Phillips. R.D. and Hung, Y.C. 2002. Overall acceptability and sensory profiles of peanut spreads fortified with protein, vitamins, and minerals. Journal of Food Science 67: 1979-1985.