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Sensory Quality of Pilot-Scale Prebiotic Chocolates in Malaysia

(Kualiti Sensori Coklat Prebiotik Skala Loji Pandu di Malaysia)

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ABSTRACT

Prebiotic, such as inulin, has been applied as functional food and known for its various health benefit effects such as increased mineral absorption, improved immune response and colorectal cancer prevention. An attempt was made to determine the level of Malaysian consumers' acceptance and market potential of newly developed pilot scale prebiotic milk chocolates (MC-1) and dark chocolates (DC-1) with no sugar added as compared to control milk and dark chocolate (containing sugar), MC-0 and DC-0, respectively. Trained panels were employed to evaluate the sensory quality of the chocolate products using the quantitative descriptive analysis (QDA) technique and the 7-point hedonic scale was used by consumer panels. In comparison with control milk chocolate (MC-0), consumer and trained panels gave better ($p<0.05$*) overall acceptance score for MC-1. Both MC-1 and DC-1 showed similar smoothness attribute (*$p>0.05$*) as control chocolates (MC-0 and DC-0). Similar likeness were shown by both trained panels and untrained Malaysian public consumers, where prebiotic milk chocolate MC-1 was the most preferred compare to prebiotic dark chocolate DC-1. This could be due to bitter taste driven by high cocoa liquor content in dark chocolate compared to milk chocolate. However, both type of prebiotic chocolates have high potential (>70%) to be bought by Malaysian consumers once introduced in the market.*

Keywords: Consumer preferences; dark chocolate; milk chocolate; pilot plant scale; trained panel

ABSTRAK

Prebiotik, seperti inulin, begitu dikenali sebagai makanan berfungsi kerana memberikan pelbagai manfaat kesihatan antaranya meningkatkan penyerapan mineral, meningkatkan tindak balas imun dan membantu pencegahan kanser kolon. Kajian telah dilakukan untuk menentukan tahap penerimaan pengguna Malaysia dan menilai potensi pasaran coklat susu (MC-1) dan coklat gelap (DC-1) prebiotik tanpa gula yang dihasilkan secara skala loji pandu berbanding coklat susu dan coklat gelap kawalan (mengandungi gula), MC-0 dan DC-0. Analisis deskriptif kuantitatif (QDA) digunakan untuk menilai kualiti sensori produk yang melibatkan panel terlatih manakala teknik skala hedonik 7-titik digunakan oleh panel pengguna. Panel pengguna dan terlatih menunjukkan penerimaan keseluruhan yang lebih baik ($p>0.05$*) terhadap coklat susu prebiotik, MC-1 berbanding coklat susu kawalan (MC-0). Kedua-dua MC-1 dan DC-1 menunjukkan atribut kehalusan yang menyamai (*$p>0.05$*) coklat kawalan (MC-0 dan DC-0). Penilaian yang baik turut diberi oleh panel terlatih dan panel pengguna, dengan coklat susu prebiotik MC-1 adalah paling disukai berbanding coklat gelap prebiotik DC-1. Ini adalah kerana rasa pahit akibat kandungan likur koko yang tinggi di dalam coklat gelap berbanding coklat susu. Walau bagaimanapun, kedua-dua jenis coklat prebiotik menunjukkan potensi yang tinggi (>70%) untuk dibeli oleh pengguna Malaysia jika diperkenalkan di pasaran.*

Kata kunci: Coklat gelap; coklat susu; pilihan pengguna; panel terlatih; skala loji pandu

INTRODUCTION

Chocolate manufacturing process has undergone various changes for the purposes of either improved oral experience (flavour and texture) or increased productivity to meet increasing demands for chocolate products. Chocolate has been widely accepted for its delicious taste, aroma and perhaps its colour. The production of newly developed prebiotic chocolates using simple technique, 3-in-1 concher (process of mixing, refining and conching done in single equipment) in a larger scale or capacity has scarcely been practised in Malaysia compared to pure chocolate containing sugar made using traditional method (separate process of mixing, refining and conching) (Norhayati et al. 2008). Moreover, producing chocolates containing functional ingredient such as inulin to be a sugar replacer is a challenge especially in maintaining their sensory characteristics which generally leads to a decrease in consumers' acceptability. A study of Finnish consumers found that the taste of model 'functional' drinks could not be compromised for putative functional benefit (Tuorila et al. 2001). Thus, sensory evaluation such as quantitative descriptive analysis (QDA) by trained panels and consumer affective test do play important roles in comparing conventional food products to a prototype product created at a lab or at a pilot scale. The relation between the two makes it possible to determine sensory profiles best adapted to the concept of the product quality in the target market enabling large companies to establish control activities,

improve quality and develop new products (Perezlortondo et al. 2007).

QDA method is based on the principle of a panelist's ability to describe their perceptions of a product in a reliable manner. Panelists are screened and trained in the attribute recognition and scaling, used a common and agreed sensory language and finally products are scored on repeated trials to obtain a complete, quantitative description (ASTM 1992). Information obtained from the description of the sensory characteristics of food and beverages enable companies to make more informed business decisions. For chocolate sensory evaluation, the most influential sensory parameters or attributes perceived by consumers are the sweetness, smoothness, hardness, color intensity and glossiness (Becket 1994). Differences in chocolate sensory characteristics are commonly associated with the varieties of cocoa, the composition of raw materials, the use of milk crumb instead of milk powder, the mixing techniques and the various processing steps (Jackson 1999). In the European and American diet, cocoa solids represent a significant source of polyphenols (Vinson et al. 2006), which are discussed for being beneficial in heart and vascular protection through their antioxidative activity (Ding et al. 2006; Engler & Engler 2006).

Sensory evaluation is also used for quality control purposes, product development and optimization of processes, taste or flavor analysis and understanding of consumer reactions towards a product (Piggott 1995). New food product development using various functional food ingredients, such as inulin, is in line with consumer requirement for value adds food. Inulin is a carbohydrate built up from β(2,1)-linked fructosyl residues mostly ending with a glucose residue and it is present as a storage carbohydrate in a number of plants (Ritsema & Smeekens 2003). Inulin ingestion affords the benefits inherent, not only, to its condition as a dietary fiber (reducing blood cholesterol and lipid levels, intestinal traffic control and increasing calcium adsorption), but also those derived from its prebiotic nature, related mainly to stimulation of bifidobacteria growth and regulation of intestinal flora in the colon (Roberfroid & Slavin 2000).

Therefore, this study was carried out to elucidate the level of Malaysian consumers' preference and the market potential (willingness-to-pay) of prebiotic chocolates (MC-1 and DC-1) produced at a pilot plant scale. A sensory technique, QDA, was applied by trained evaluation panels, while the 7-point hedonic scale by untrained consumer panels to judge their preferences. This is also to forecast the marketability of the chocolate products and consumer behavioral pattern.

Materials and Methods

Ingredients such as sugar, cocoa butter, cocoa mass, milk powder and emulsifier were used to produce control (traditional) milk and dark chocolate. Formulations of prebiotic milk chocolate and dark chocolate were designed to contain ratios (inulin:isomalt) of 20-35% inulin and 5-15% isomalt (a sugar alcohol as an intense sweetener) to replace sugar as per control milk chocolate (MC-0 with 44% sucrose) and dark chocolate (DC-0 with 44% sucrose) using a factorial design, 2^2 (Table 1). Two factors were used, inulin (X_1) and isomalt (X_2) at selected minimum inulin level of 200 or coded as -1, maximum level of 300 coded as 1 while minimum isomalt level was 70 (coded -1) and maximum level was 140 (1). Centre point for M1 and D1 was coded as 0 for inulin at level of 250 while code 0 for isomalt was at level 105. The factors were first tested for significant effect (p<0.05) towards texture and melting profile as a reponse (results not shown here) before selection of well formulated prebiotic chocolates finalised. Range of inulin percentage selected in this study has been reported to have bifidogenic effect (Kruse et al. 1999; Roberfroid 1996; Van Loo et al. 1995). Thus, our final MC-1 prebiotic chocolate was incorporated with inulin and isomalt at ratio of 70:30 (Table 1) while DC-1 with 74:26 ratio.

TABLE 1. Factorial design of prebiotic chocolate formulations (M2-5, D2-5), centre point (M1, D1) and control chocolates (MC-0, DC-0)

Sample	Inulin (Level)	Isomalt (Level)	Ratio Inulin (X_1): Isomalt (X_2)	Fat content (%)
MC-0	-	-	-	34.5
M1	0	0	70:30	35.8
M2	-1	-1	74:26	39.4
M3	-1	1	59:41	36.3
M4	1	1	68:32	32.7
M5	1	-1	81:19	35.2
DC-0	-	-	-	29.4
D1	0	0	70:30	32.1
D2	-1	-1	74:26	35.4
D3	-1	1	59:41	32.7
D4	1	1	68:32	29.4
D5	1	-1	81:19	31.5

Cocoa liquor was purchased from Selbourn Food Services at Pelabuhan Klang, Malaysia; full cream and skimmed milk from Promac Enterprises Sdn. Bhd.; cocoa butter from Malaysia Cocoa Manufacturing Sdn. Bhd.; isomalt from Nutrisweet & Food Specialties Sdn. Bhd.; inulin extracted from chicory root (Sensus, The Netherlands) and stored in our Pilot Plant Laboratory, Malaysia Cocoa Board, Selangor, Malaysia.

Pure or traditional chocolate processing involves the use of a chocolate mixer for mixing the chocolate components or ingredients to form chocolate paste, followed by refining step and finally conching to produce the desired chocolate texture and flavour. Mixing step should result in the production of chocolate paste physically represented by rough texture and plastic consistency (Minifie 1989), while the refining is conducted by multi-step refining systems using roll refiners. However, in this study, equipment namely 3-in-1 concher (Lloveras, Italy) was used to produce each batch of prebiotic milk and dark chocolates (MC-1 and DC-1, respectively) and control milk and dark chocolates (MC-0 and DC-0, respectively) of a larger capacity (130 kg). The 3-in-1 concher does the mixing, refining and conching steps in single equipment and has the advantage of facilitating the equipment coordination plus cost saving compared to purchasing many types of equipments.

All ingredients formulated for each type of chocolates was poured into the 3-in-1 concher, except for soya lecithin (an emulsifier) used was added 2 h before the process ended. The whole process took approximately 12 h at controlled temperature between 50-55°C (Norhayati et al. 2013). The gap between the blades in the concher was left widen at early stage of mixing for 20 min then narrowed down to have more friction by turning the rotor to 16-18 amps in order to achieve the required particle size of chocolate paste (Minifie 1989). The untempered chocolate (liquid form) can be stored in a cold cabinet at 16-20°C as chocolate blocks if the process of tempering is delayed. Tempering step was done using a pilot scale tempering machine (Sollich, Mini Temper Turbo, Germany), which requires melting the chocolate block at a temperature of 41-42°C prior tempering. This procedure will facilitate the process of tempering automatically in large quantity.

Tempered chocolate was added into a container or polycarbonate mould followed by vigorous stamping in order to compact the chocolate in the mould and then left in a chiller for 20 min. This was done to produce the desired chocolate shape (Afoakwa et al. 2007). Each chocolate developed i.e prebiotic and control chocolates, produced using the pilot scale semi-automated process was evaluated for its sensorial quality.

SENSORY EVALUATION BY TRAINED PANELS

Quantitative Descriptive Analysis Method by Trained Panels In the early stages, screened panelists were able to assess the intensity of four basic tastes (sour, sweet, bitter and salty). They tasted the control milk and dark chocolate (containing sugar; MC-0 and DC-0) as a reference sample at few different sessions to generate the appropriate terminology and described the attributes of the tested chocolate. Harmonization of results among the panelists after several discussions was reached during training sessions. This step is important to produce the terminology and the intensity of the attribute scores that best described the flavor, appearance and texture of desirable chocolate. Samples of prebiotic milk chocolate, MC-1 was evaluated together with MC-0 as control sample, while prebiotic dark chocolate, DC-1 was compared with control dark chocolate (DC-0) using terminology that has been agreed by the panelist. A total of 12 trained panelists assessed the intensity of milk chocolate and dark chocolate attributes comprising hardness, meltdown, sweetness, milk taste (milk chocolate), bitter taste (dark chocolate) and overall acceptance. Quantitative descriptive analysis (QDA) methodology was adopted. According to the QDA procedure (Aminah 2000), each chocolate sample to be analyzed should be given a code of 3 random digits. Panelists were requested to evaluate the attributes using 7-point line scale, where attributes such as hardness with score 1 referred as very soft (weak intensity), score 4 - medium while score 7 means very hard (high intensity) and the same goes to other attributes in reporting degree of sensorial characteristics assessed for each chocolate sample. Each panel should rinse their mouth by eating biscuit before tasting the next chocolate sample.

SENSORY EVALUATION BY CONSUMER PANELS

The sensory evaluation of treated and control chocolate samples was carried out at 6th China Import & Export Commodities Exhibition held at Kuala Lumpur Convention Centre and Malaysian Cocoa Fair held at Berjaya Times Square, Kuala Lumpur (urban area of Centre Malaysia). It is aimed to collect more information regarding preference or acceptance of prebiotic chocolates compared to traditional or pure chocolates (control). Participants i.e teenagers: aged between 10-19, adult: aged 20-39 and senior adult: aged ≥ 40 years (target consumers) were randomly invited to taste and evaluate all samples provided. A total of 100 participants involved in evaluating the prebiotic milk (MC-1) and the control chocolates (MC-0). Meanwhile, a total of 84 panelists participated in tasting prebiotic dark (DC-1) and control chocolates (DC-0). The number of consumer participants (sample collection number) was based on and recommended by ASTM (1968) protocol.

To reduce the occurrences of biasness in judgment, the potential candidates must indicate their honest view on the admirability consuming and type of preferred chocolates prior to sample evaluation. The involvement of unqualified panels may add variability in results obtained thus discovering false differences (Aminah 2000). In addition, information on ingredients used in tested chocolate and the benefits towards health contribution have been kept confidential. A total of 6 attributes (hardness, milk taste for milk chocolate product, bitter taste for dark chocolate,

smoothness, meltdown, sweetness and overall acceptance) were assessed and panels were required to give a score according to the hedonic scale of the most suited describing the attributes of each chocolate sample.

QUANTITATIVE DESCRIPTIVE ANALYSIS METHOD BY CONSUMER PANELS

The desire of consumers to choose and consume certain food product can be determined through sets of questions based on three key categories: product, situation (purchase or consumption) and packaging (Viaene & Januszewske 1999).

A total of 91 participants or respondents aged between 15-45 years were given a set of questionnaires to answer before proceeding to sensory evaluating samples of prebiotic dark chocolate (DC-1), while another 119 respondents were participated in answering questionnaires related to prebiotic milk chocolate (MC-1). Respondents were required to taste the chocolate samples and answer questions such as whether they are chocolate lovers, their frequency of eating chocolate, whether they like the sweetness of the tested prebiotics chocolate samples and whether they are willing-to-pay for prebiotic chocolates once available in the market. The information or data was useful to determine whether the newly developed chocolate is suitable for marketing or brought back to the laboratory for modification (Aminah 2000).

STATISTICAL ANALYSIS

All data were analyzed using SPSS (version 16.0) to find significant differences between the mean of each sensory attribute and the sample at the level of $p<0.05$ using t- test (a comparative test).

RESULTS AND DISCUSSION

SENSORY EVALUATION BY TRAINED PANELS

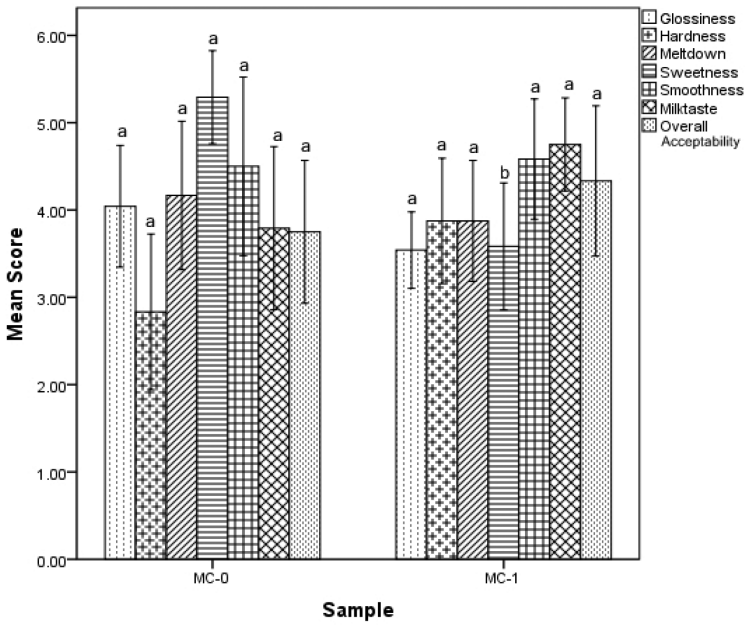
Comparison of mean scores of milk chocolate MC-0 and MC-1 by trained panelists through the t-test is shown in Figure 1. The result exhibited that the sweetness attribute was significantly different ($p<0.05$) compared with control sample. The result showed that the significant difference ($p<0.05$) existed only for sweetness attribute. MC-0 received a higher sweetness score (5.3) compared to MC-1 (3.6). However, the assessment showed that there was no significant difference ($p>0.05$) for other attributes especially in terms of the overall acceptance. This means that prebiotic milk chocolate (MC-1) has similar sensorial characteristics as per control chocolate (MC-0). Panelists gave higher scores ($p>0.05$) for the MC-1 overall acceptability attribute (mean score of 4.3), milk taste (4.8) and smoothness (4.6) compared to MC-0 with its overall acceptance mean score at 3.8, milk taste (3.8) and smoothness (4.5), respectively.

The prebiotic milk chocolate (MC-1) developed using 3-in-1 concher showed similar quality as per control (MC-0), in terms of the smoothness and overall taste of traditional/ pure milk chocolate generally containing high sugar. This result was in contrast with the lab scale production method (separate process of mixing, refining and conching) where the trained panels gave higher scores to MC-0 particularly in terms of its attributes of smoothness (score 4.1) and overall acceptance (score 3.9) compared to MC-1 at the score of 3.0 and 3.8, respectively (Norhayati et al. 2008). It is further proven that with the utilization of the 3-in-1 concher, the sensory characteristic of prebiotic milk chocolate can be improved.

Figure 2 shows the score for control dark chocolate (DC-0) and prebiotics dark chocolate (DC-1). Significant difference ($p<0.05$) in melting down attribute (chocolate melted after 30 seconds in the mouth), sweetness and overall acceptance was observed by panelists. DC-0 was defined as easily melted (mean score of 4.2), more sweet (mean score 4.3) and better overall acceptance (mean score 4.6) than DC-1 (mean score of 3.1, 2.8 and 3.2, respectively). However, the different score for DC-1 (4.0) and DC-0 (4.8) was not significantly different ($p>0.05$). Thus, it shows that DC-1 had maintained the desired smoothness similar to ordinary dark chocolate (Norhayati et al. 2008). The panel also stated that DC-1 was harder (mean score 5.0) than DC-0 (mean score 4.5), but not significantly different ($p>0.05$). Substitution of sugar component with inulin and isomalt has highly influenced the dark chocolate hardness compared with control chocolate and the same result was also achieved by prebiotic milk chocolate (MC-1 was harder than MC-0).

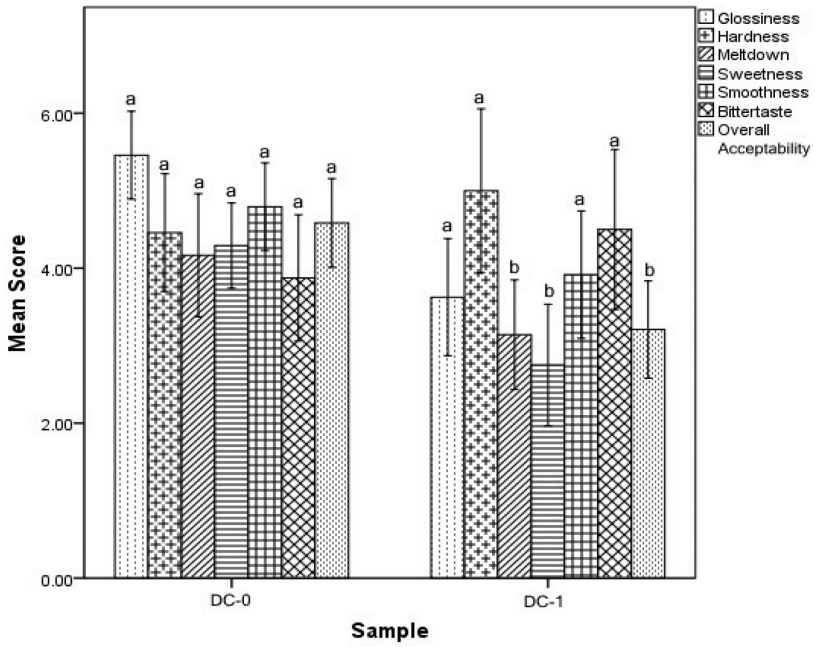
However, the results of sensory evaluation by trained panels for both type of prebiotic chocolates were different from the (Texture Analyser Model TA-XT21, UK) results where both type of prebiotic chocolate texture were measured as less harder than other types of control chocolate ($p<0.05$) (Norhayati 2010). According to Piggot (1995), sensory evaluation method although being costly, it is the closest tool to measure human perception compared to equipment, even though the sensory measurement is said to be quite subjective.

Meltdown sensory attribute showed significant difference ($p<0.05$), where DC-1 was perceived as not easily melted in the mouth (lower scores) compared to DC-0. However, there was insignificant difference ($p>0.05$) between sample DC-0 and DC-1 as well as the glossiness attribute. It should be clearly noted that no changes were made on cocoa fat content for both types of prebiotic chocolates. Dark chocolate (DC-1) (without sugar) was also scored as bitter (but insignificant difference) and less sweet than DC-0. The sweeter taste of DC-0 and less bitterness may have influenced the overall acceptance, when the DC-0 was more preferred than the DC-1. Pearson correlation test showed that there was a significant positive correlation ($r=0.6, p<0.01$) between the sweetness attribute and overall acceptance. The results showed that the higher the sweetness level of dark chocolates, the better the acceptance of dark chocolate will be. The study by Lauro et al. (2009) on diabetic or reduced calorie chocolate also indicated that the chocolate with a bitter taste was less accepted (bitterness is a source for the selection of 'dislike') than the traditional chocolate.



[a,b] Different letters represent siginificant different of mean for each attributes at $p<0.05$

FIGURE 1. Mean ± sd score of sensory attributes of milk chocolate samples (MC-0 and MC-1) judged by trained panels (n=12)



[a,b] Different letters represent siginificant different of mean for each attributes at $p<0.05$

FIGURE 2. Mean ± sd score of sensory attributes of dark chocolate samples (DC-0 and DC-1) judged by trained panels (n=12)

SENSORY EVALUATION BY CONSUMER PANELS

Comparison between Sensorial Attributes and Overall Acceptability Towards Prebiotic Milk and Dark Chocolates

The use of QDA technique to describe food attributes by consumer panels is considered as not analytical and less accurate than by trained panels (Sune et al. 2002). Therefore, each attributes applied during panel training session will be reiterated in this study for consumer panels, except for glossiness and was further simplified by using 7-point hedonic scale for comparison and selection

purposes. Glossiness attribute was not used in this session as there was no significant difference ($p>0.05$) as reported by trained panels for the chocolates. This can prevent perceptual disorder (confuse) or sense of not interested among the respondents participating in the evaluation session. According to our observations, the consumer panels would prefer simple questions to be posed and require less time to be responded.

Out of the total 184 consumer respondents, it is confirmed that the involvement in the evaluation of milk chocolates by 100 respondents and dark chocolates by 84 respondents. Among the respondents, 68% female respondents have evaluated milk chocolate (Figure 3(ai)) and 60% of them evaluated dark chocolates (Figure 3(bi)). Meanwhile, Figure 3(aii) shows that the age of adolescents at the age of 21-30 years old were mostly (40%) engaged in the preference toward tasting the two types of chocolates. Those above 41 years was more likely to taste dark chocolates (23.8%) than milk chocolates (15.5%). Figure 4 shows the scores for all attributes (hardness, milk taste, smoothness, meltdown, sweetness and overall acceptability) assessed by consumers on prebiotic milk chocolate (MC-1), which showed no significant difference ($p>0.05$) compared with control chocolate (MC-0). Almost all attributes of MC-1 and MC-0 samples had moderate scores between 3.7 and 4.8.

The highest score was given on the overall acceptability attributes of MC-1 with similar value to MC-0 which is categorized under the 'like' category. This showed that MC-1, prebiotic milk chocolate manufactured at a pilot scale has the characteristic that was well accepted by consumers, even if it is not the same as being assessed by the trained panels that 'like' MC-1 more than MC-0 (Figure 5). In contrast with Lauro et al. (2009), who discovered that their consumers tend to prefer traditional milk chocolate containing sugar (overall acceptance $p<0.05$) compared with diabetic milk chocolate. Based on consumers' age factor, higher percentage of respondents (2%) aged between 10-20 years had expressed MC-1 as 'like very much' compared to age group above 41 years (1%) (Figure 6). Age category 21-30 year showed a high percentage of 'like' (8.5%), 'like very much' (5.5%) to MC-0 and 'dislike very much' to MC-1 (0.5%).

Those respondents at the age of 21-30 years exhibited higher percentage for the 'like' category (4.5%) and 'like very much' (3.0%) of MC-1 compared with other age groups. This further exhibited that they also have higher buying power compared to other age groups. Secondly, a dynamic change in interest or likeness occurs more rapidly in younger people. It is proven that curiosity, naiveness and adventurosity occur in the juvenile years of human being. Therefore, exposure to different food taste to the age group may change their food preference and eating patterns that may contribute to important changes in food attributes and degree of confidence in product goodness (Januszewska & Viaene 2001). Consumers within 31-40 years have critically exhibited a higher percentage of 'like very much' (1.5%) and described 'like' (4%) to MC-1 more than MC-0.

For dark chocolate, consumer panels have evaluated DC-1 as significantly different ($p<0.05$) from DC-0 for its hardness, bitterness, sweetness and overall acceptability attributes (Figure 7). DC-1 was assessed as 'moderate' for the overall acceptability compared to DC-0 which categorized as 'like'. Sensory evaluation of dark chocolate by consumer

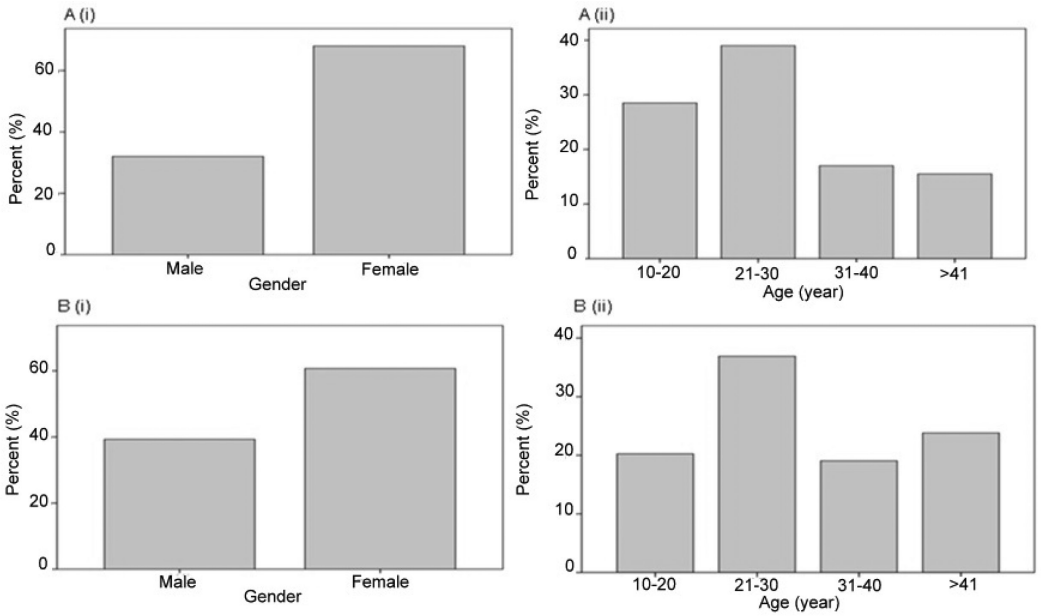
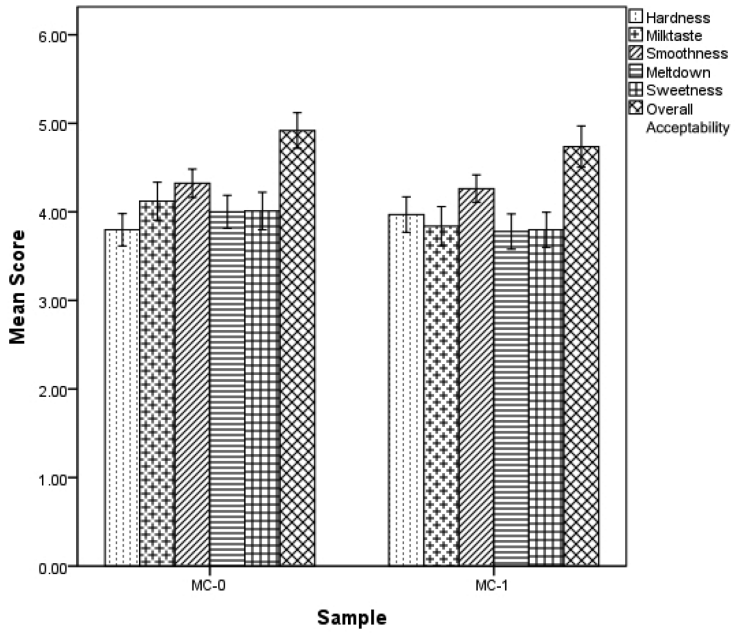


FIGURE 3. Demographic analyses on consumer respondents a(i): gender preference towards milk chocolate; a(ii): age preference towards milk chocolate; b(i): gender preference towards dark chocolate; b(ii): gender preference towards dark chocolate



No significant different at $p>0.05$

FIGURE 4. Comparison of mean±sd score sensorial attribute for prebiotic milk chocolate (MC-1) and control milk chocolate (MC-0) judged by consumer panels (n=100)

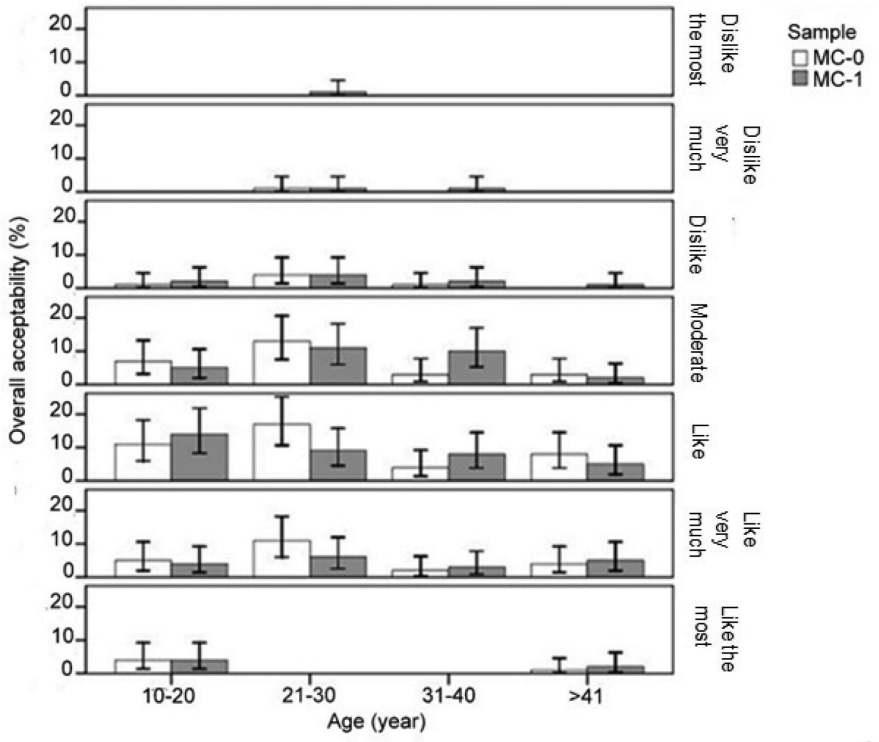
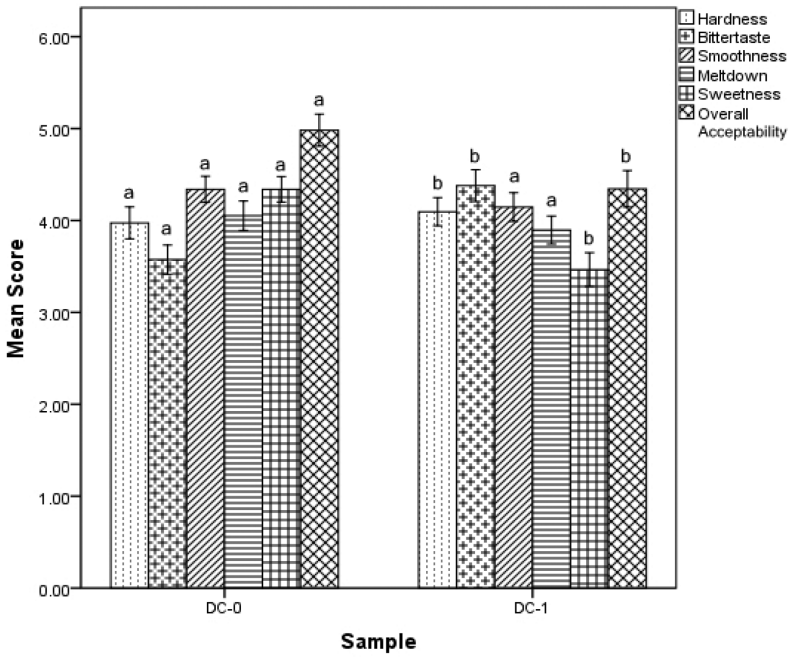


FIGURE 5. Comparison of overall acceptability percentage between MC-0 and MC-1 as judged by consumer panels

panel shared similar score as by trained panel, where DC-1 was assessed as less sweet, more bitter and different from DC-0 that ultimately influenced the overall acceptance of the DC-1. However, based on one of the physical properties such as hardness, most consumer panels preferred DC-1 rather than DC-0.

In terms of age category, the panel ages between 21-30 years showed a high percentage in assessing DC-0 as 'like the



[a,b] Different letters represent siginificant different of mean for each attributes at $p<0.05$

FIGURE 6. Comparison of mean ± sd score of sensory attributes and overall acceptability of prebiotic dark chocolate (DC-1) and control dark chocolate (DC-0) as judged by consumer panels (n=84)

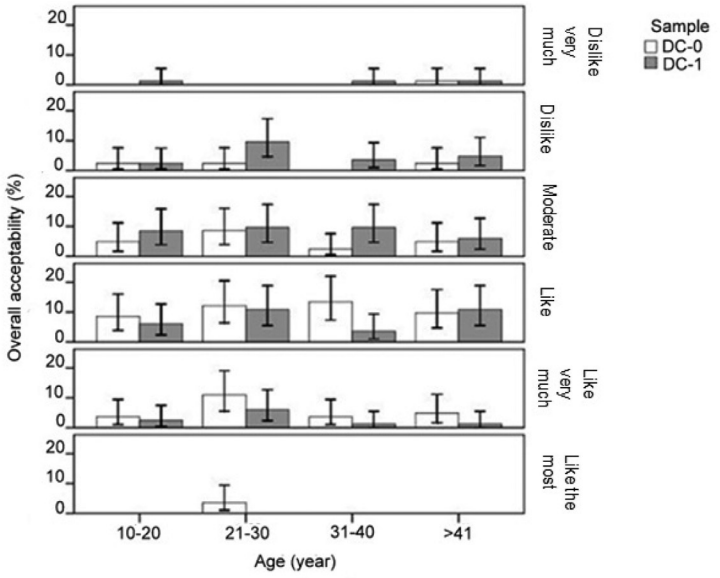


FIGURE 7. Comparison of overall acceptability for DC-0 (control dark chocolate) and DC-1 (prebiotic dark chocolate) as judged by consumer panels

most' (1.8%), while 6.1% scored 'like' (Figure 7). However, higher percentage (5.5%) of above 41 years old consumers scored 'like' for DC-1 compared with DC-0 (4.8%). There were differences in degree of preference between younger and older generations in this study and as reported by other study (Birch 1990). Due to less acceptability of prebiotic dark chocolate (DC-1) by both trained and consumer panels than the DC-0, hence it is necessary to improve the sensory qualities of DC-1, particularly its sweetness and bitterness. Such sensory data provides useful information for both the researchers and manufacturers to consider in improving the preferred quality of the DC-1 without altering the nutritional content of the prebiotic chocolate. Gatchalian (1989) also stressed that the consumer assessment need to be considered in order to fit into the product quality improvement as fundamental decision for researchers to make.

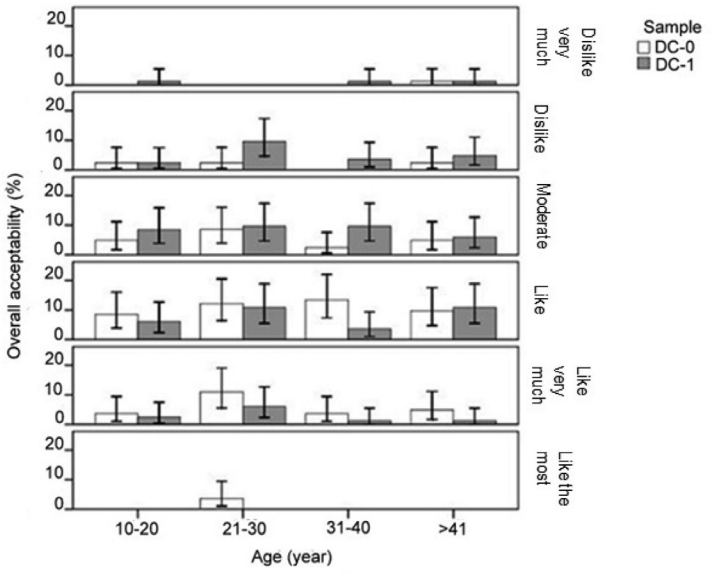


FIGURE 8. Comparison of overall taste preference for MC-1 (prebiotic milk chocolate) as judged by consumer panels

MARKET SURVEY AND DEMAND

A further study was conducted to determine the potential acceptance of prebiotic chocolate; MC-1 and DC-1 in the market without being biased by the different types of chocolate (containing sugar). In this study, questionnaires for prebiotic milk chocolate, MC-1 (Table 1) showed that more female respondents (64.7%) were involved than male (35.3%). Majority of the respondents aged between 26-35 years (37.8%) and who often eat chocolate once a month (41.2%), followed by twice per week (26.1%) and finally in once every two weeks (12.6%).

Frequency of individual exposure to certain food was reported to be very important even though the consumer respondents are untrained evaluators and their evaluation was not considered analytical, but the frequency of exposure to the food influenced the level of the individual's preference towards certain product (Januszewska & Viaene 2001). The result from this study also indicated that many consumers love sweet milk prebiotic chocolate (92.4%) and most of them had expressed for overall taste as 'tasteful' (71.8%), followed by 'very tasteful' (20.5%) and none has stated as 'not tasteful'. Many respondents (90.7%) expressed their desires to buy the chocolates once placed over-the-counter. This was regarded as a new attraction in chocolate market that offer health benefits to chocolate lovers.

A comparison of overall acceptance of MC-1 was made (Figure 8) based on age factor. The age group of 26-35 scored MC-1 as 'very tasteful' and 'tasteful' than the other age group with higher percentage (24.8%) towards taste assessment of 'tasteful' for MC-1. This finding is furthermore encouraging because consumers aged 20-30 years old as mentioned above was the target group with the credibility of buying power that exceeded other age groups. Respondents at the age of 15-25 years old were the second highest (21.4%) claiming that MC-1 as 'tasteful'. None of the respondents from the four range of age groups expressed MC-1 as 'not tasteful'. Based on this study, younger generation (15-35 years) from urban area was attracted to prebiotic milk chocolate due to its fine taste and their awareness on its contribution to health. Survey results in Table 2 shows that huge number of respondents tasting the dark chocolate (DC-1) were female (67%) rather than male (33%), while majority of them aged between 15-25 years (36.3%). Respondents involved in this session were eating chocolate more frequently, which are twice a week (29.7%) compared to milk chocolate with only once per month. Respondents also liked the sweetness of the DC-1 (72.5%), despite the relatively weak percentage to prebiotic milk chocolate (92.4%). The disparity could due to its bitter taste, which is claimed by the remaining 27.5% of respondents.

There were small number of respondents who answered 'not tasteful' (3.3%) to the overall taste of prebiotic dark chocolate (DC-1) and it was different from prebiotic milk chocolate evaluation (0%). Based on Figure 9, those at 15-25 years and over 45 years of age were identified as among the contributors to the overall sensory response DC-1 as 'not tasteful' by 2.2% and 1.1%, respectively. This may due to consumers' reactions who are not fond of the bitter taste caused by the quantity of cocoa (caffeine and theobromine are natural compounds of plant species) present was more than in milk chocolate. It should be noted that the bitter chocolate has higher content of antioxidant, flavonoids and nutrient level compared with milk chocolate (Yumi et al. 2009). However, 56% participants originated from total of 91 respondents expressed the overall taste of DC-1 as 'tasteful'. These results were almost parallel with comparison test made by trained panel and consumers between DC-0 and DC-1, where DC-1 was generally less accepted. Figure 9 also shows that those respondents within the range of 26-35 year old, followed by 15-25 years old were the most, who evaluated

DC-1 as 'tasteful'. Meanwhile, respondents at the age of 26-35 years claimed DC-1 as 'very tasteful' (Table 3).

Prebiotic dark chocolate DC-1 has the potential to penetrate the chocolate market and industry, whereby

TABLE 2. Response by consumers on prebiotic milk chocolate (n = 119)

	Criteria	Variable	Respondent Percentage Value (%)
1.	Gender	Male	35.3
		Female	64.7
2.	Age (year)	15-25	26.9
		26-35	37.8
		36-45	17.6
		> 45	17.6
3.	Occupation	Student	19.3
		Private	37.8
		Government	20.2
		Own bussiness	22.7
4.	Frequency of eating chocolate	Once a week	20.2
		Twice a week	26.1
		Once every two weeks	12.6
		Once a month	41.2
5.	Like its sweetness ?	Yes	92.4
		No	7.6
6.	Overall taste	Very tasteful	20.5
		Tasteful	71.8
		Less tasteful	7.7
		Not tasteful	0.0
7.	Are you willing to pay if available in the market?	Yes	90.7
		No	9.3

TABLE 3. Response by consumers on prebiotic dark chocolate (n=91)

	Criteria	Variable	Respondent Percentage Value (%)
1.	Gender	Male	33.0
		Female	67.0
2.	Age (year)	15-25	36.3
		26-35	28.6
		36-45	17.6
		> 45	17.6
3.	Occupation	Student	31.3
		Private	26.7
		Government	24.4
		Own bussiness	17.8
4.	Frequency of eating chocolate	Once a week	25.3
		Twice a week	29.7
		Once every two weeks	16.5
		Once a month	28.6
5.	Like its sweetness ?	Yes	72.5
		No	27.5
6.	Overall taste	Very tasteful	15.4
		Tasteful	56.0
		Less tasteful	25.3
		Not tasteful	3.3
7.	Are you willing to pay if available in the market?	Yes	73.3
		No	26.7

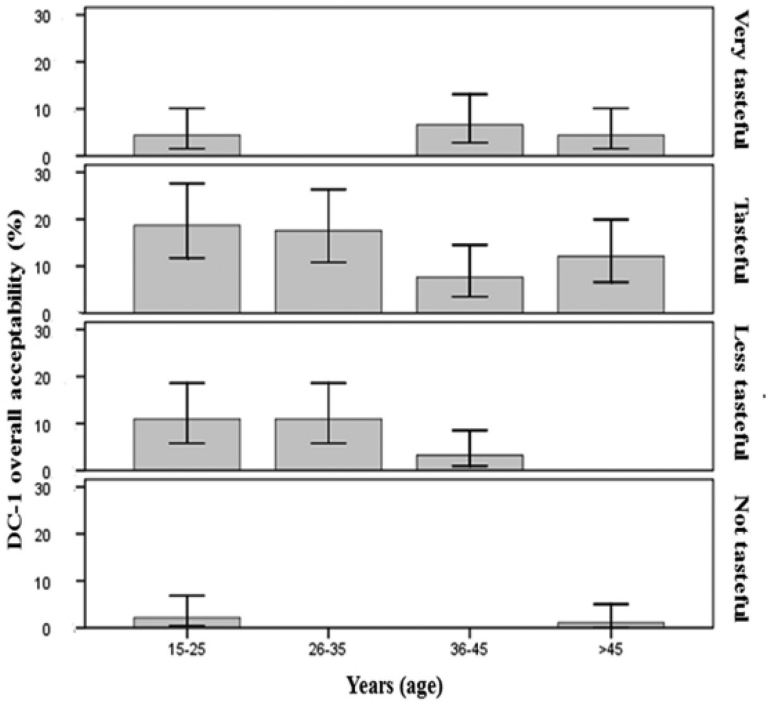


FIGURE 9. Comparison of overall taste preference for DC-1 (prebiotic dark chocolate) as judged by consumer panels (n=84)

73.3% respondents claimed their preference to purchase DC-1 product once available in the market despite its bitter taste. Furthermore, dark chocolate is best known for its highest antioxidant content compared with milk and white chocolate. Therefore, it is best to study the effect of recommended consumption of the prebiotic dark chocolate on the reduction of global obesity rate for future research. Consumers' acceptance could be further enhanced if DC-1 can be improvised based on the assessment and conclusive facts made by the trained panels (descriptive methods) and consumer panels (hedonic scale). Referring to consumer' comments as a whole, prebiotic chocolate MC-1 and DC-1 has the potential for commercialization based on their health benefits. Increasing range of estimated sample size comprised of 50-100 people is highly recommended in order to provide a more selective positive results (ASTM 1968).

CONCLUSION

The study showed that prebiotic (sugar free) milk chocolates (MC-1) produced in a pilot scale quantity, has the overall acceptability better (p>0.05) than control (with added sugar) chocolates (MC-0), when assessed by both trained and consumer panels. Prebiotic chocolates showed similar score on smoothness attribute (p>0.05) compared with control chocolates. The results of sensory evaluation conducted by trained panels were highly correlated with perception or acceptance of consumer panels. This could be a stepping stone for the researchers to make changes to the existing prebiotic chocolates. Preferences of consumers in this study showed that they prefer MC-1 better than DC-1 due to the distinctive bitter taste of the dark chocolates. However, both types of prebiotic chocolates showed an encouraging potential (exceeded 70%) to be purchased by consumers if available in the market.

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