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Similar taste-nutrient relationships in commonly consumed Dutch and Malaysian foods

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Abstract

Three recent studies showed that taste intensity signals nutrient content. However, current data reflects only the food patterns in Western societies. No study has yet been performed in Asian culture. The Malaysian cuisine represents a mixture of Malay, Chinese and Indian foods. This study aimed to investigate the associations between taste intensity and nutrient content in commonly consumed Dutch (NL) and Malaysian (MY) foods. Perceived intensities of sweetness, sourness, bitterness, umami, saltiness and fat sensation were assessed for 469 Dutch and 423 Malaysian commonly consumed foods representing about 83% and 88% of an individual's average daily energy intake in each respective country. We used a trained Dutch (n=15) and Malaysian panel (n=20) with quantitative sensory Spectrum™ 100-point rating scales and reference solutions, R1 (13-point), R2 (33-point) and R3 (67-point). Dutch and Malaysian foods had relatively low mean sourness and bitterness (<R1), but higher mean sweetness, saltiness and fat sensation (between R1 and R2). Mean umami taste intensity of Malaysian foods (15-point) was higher than that of Dutch foods (8-point). Positive associations were found between sweetness and mono- and disaccharides (R^2=0.67 (NL), 0.38 (MY)), between umami and protein (R^2=0.29 (NL), 0.26 (MY)), between saltiness and sodium (R^2=0.48 (NL), 0.27 (MY)), and between fat sensation and fat content (R^2=0.56 (NL), 0.17(MY)) in Dutch and Malaysian foods (all, p<0.001). The associations between taste intensity and nutrient content are not different between different countries, except for fat sensation-fat content. The two dimensional basic taste-nutrient space, representing the variance and associations between tastes and nutrients, is similar between Dutch and Malaysian commonly consumed foods.

Keywords:

Taste intensity; nutrient content; commonly consumed; foods; cross-cultural

Introduction

The sense of taste plays a pivotal role in food choice and preference (Drewnowski, 1997). It has been hypothesized that taste has a nutrient-signaling function and is able to elicit expectations about foods concerning its macronutrient content (Rozin & Vollmecke, 1986; Temussi, 2009). Sweet taste, for example, may signal energy and carbohydrate content, umami and salty tastes may signal protein and sodium content, bitter taste may indicate toxic components, and sour taste may indicate ripeness of fruits (Temussi, 2009; Yarmolinsky, Zuker, & Ryba, 2009). This signaling function of taste has repeatedly been shown to affect the process of satiation, meal termination (Bolhuis, Lakemond, de Wijk, Luning, & de Graaf, 2011; de Graaf & Kok, 2010; Weijzen, Smeets, & de Graaf, 2009). Taste signaling is therefore important in the regulation of food and energy intake (McCrickerd & Forde, 2016).

There is an enormous societal pressure both in middle and high income countries in the world to reduce salt, sugar and fat levels in foods (World Health Organization, 2013). However, attempts to reduce these levels face the challenge of keeping sensory perceptions of tastes at optimal levels (Zandstra, Lion, & Newson, 2016). From this perspective it is important to have insight in the relationships between the physical chemical/nutrient composition of commonly consumed foods and the sensory perception of taste.

Taste perception has also been implicated from an obesity perspective. A recent comprehensive review of Cox et. al. (2016) suggested that lower sensitivity to fat taste and higher liking and preference for fat is related to an higher average BMI. There was little evidence of a relationship between sweet, salty, sour or bitter tastes sensitivities, preferences and weight status (Cox, Hendrie, & Carty, 2016). Since taste plays a prominent role in potential nutrition-related health

outcomes, it is important to assess the relationship between taste intensity and nutrient content of a wide range of foods representative of diets within and across population.

Only recently studies started to explore the taste-nutrient relationship of commonly consumed foods, in order to better understand the role that taste properties may play in food intake regulation. So far, three studies; originated from the Netherlands (van Dongen, van den Berg, Vink, Kok, & de Graaf, 2012), Australia (Lease, Hendrie, Poelman, Delahunty, & Cox, 2016) and United States (van Langeveld, et al., 2017), have described the association of taste intensity and nutrient content within respectively 50, 377 and 237 consumed foods. The three studies consistently observed that sweet, salty, umami and fat sensation were positively associated with respectively mono- and disaccharides, sodium, protein and fat content. Moreover, energy content of consumed foods was positively associated with saltiness but not with sweet taste intensity in the Australian and American foods. However, these studies only investigated the nutrient-taste relationships in Western food patterns.

Food intake usually takes place within a range of familiar foods, which highly depend on cultural exposure and individual experience (Prescott, 1998; Rozin, 1996). The wide variety of regional cuisines makes the taste qualities in foods different all over the world. For instance, Western cuisines tend to pair foods that share flavors; whereas East Asian dishes does opposite and avoid combining similar flavors (Ahn, Ahnert, Bagrow, & Barabási, 2011). These cultural diversities of culinary practice and food patterns raise the question of whether these general patterns on taste-nutrient associations are similar across Western and Asian food patterns. However, up to now, no study has been performed to characterize the taste-nutrient relationships of commonly consumed foods in Asian culture.

In this paper, we investigate the association between taste intensity and nutrient content in commonly consumed Dutch and Malaysian foods. It was hypothesized that similar taste-nutrient relationships will exist in both Dutch and Malaysian foods regardless of different cultural backgrounds.

Material and methods

This study linked the taste profiles of commonly consumed foods in The Netherlands and Malaysia with the nutrient content of those foods. The commonly consumed foods have been selected using nation-wide food consumption data from each country.

Panelists

A Dutch (n=15) and Malaysian trained sensory panel (n=20) was used to describe a wide array of commonly consumed Dutch and Malaysian foods in terms of the intensity of five basic tastes (i.e. sweet, sour, bitter, umami, salt) and fat sensation. The Dutch panel consisted of 3 males and 12 females, with a mean age of 33±12 years and a BMI of 23±2 kg/m^2. The Malaysian panel consisted of 3 males and 17 females, with a mean age of 21±3 years and a BMI of 22±4 kg/m^2. Both panels were screened for good sensory ability and trained intensively (56-63 hours, 6 months) using 100-point Spectrum^{TM} inspired quantitative reference rating scales (Martin, Visalli, Lange, Schlich, & Issanchou, 2014; Muñoz. & Civille, 1992). (Teo et al., under review)

All panelists signed an informed consent form and received financial compensation for participation in the study. The study has been approved by the Human Ethics Review Committee

of Wageningen University (ABR number: **NL47315.081.13**) and Taylor's University (Ethics reference number: **HEC/2015/SBS/023**). The study was conducted according to the declaration of Helsinki and registered on ClinicalTrials.gov (**NCT03233503**).

Panel training

Both panels received an intensive training to evaluate the intensity of sweetness, sourness, bitterness, umami, saltiness and fat sensation. Panelists were trained using basic sapid taste solutions, followed by simple modified products and commercially available food products. Spectrum-based basic solutions were available with fixed reference points at 13.3 point (R1), 33.3 point (R2) and 66.7 point (R3) for each taste modality on a 100-point rating scale. For saltiness, the positions of R1 (16.7 point) and R3 (56.7 point) were different. Basic solutions contained increasing concentrations of sucrose for sweetness, sodium chloride (NaCl) for saltiness, monosodium glutamate (MSG) for umami, citric acid for sourness and caffeine for bitterness. The taste compounds were dissolved in mineral water (Evian®, Évian-les-Bains, France). The reference solutions on the rating scales were obtained from the Spectrum™ method (Muñoz. & Civille, 1992). MSG concentrations for umami taste were adapted from the previous work of the Dijon group (Martin, Tavares, Schwartz, Nicklaus, & Issanchou, 2009). Next, panelists were trained using simple food matrices which were modified with varying concentrations of taste substances. For instance, NaCl and MSG were added to mashed potatoes and cooked rice for saltiness and umami; caffeine and citric acid were added to agar for bitterness and sourness; sucrose was added to gelatin for sweetness; and mascarpone was added to vanilla custard for fat sensation. This part of training was completed when the panels were able to

discriminate different taste intensities and reproduce taste values in samples with different textural conditions.

Panelists then discussed, evaluated and rated perceived taste intensity of pre-selected commercially available reference foods on the line scales with the aid of the reference solutions. Foods with the largest variability between panelists were then excluded. Group discussions and individual training were repeated until consensus about taste and fat sensation of reference products was reached (i.e. each mean taste value was remained as non-statistically significantly different, and a coefficient of variation lower than 50% was obtained). The panels also received additional training sessions with regard to the taste attributes that appeared to be more difficult based on the results of the panel agreement, i.e. umami, bitter and fat sensation. At the end of training procedure, this resulted in 26 additional reference positions on the six rating scales, with the reference foods being specifically targeted for Dutch and Malaysian panel (see **Table 1.**) (Teo et al, under review).

144 **Table 1.** Reference solutions, reference foods, and their fixed position on the 100-point rating scales

Sensation	Reference solutions		Dutch reference foods		Malaysian reference foods	
	Solution	% scale	Food	% scale	Food	% scale
Sweet	Sucrose 20gL^{-1} (R1)	13[a]	Knappertjes (biscuits) Verkade®	20	Marie biscuits Munchy®	21
	Sucrose 50gL^{-1} (R2)	33[a]	Vanilla vla (Vanilla custard) Friesland Campina®	33	Tiger biscuits Mondelez International®	39
	Sucrose 100gL^{-1} (R3)	67[a]	Sponge cake Albert Heijn home brand®	50		
			Marshmallow Haribo®	67	Marshmallow Haribo®	64
			Sweetened condensed milk Friesland Campina®	88	Sweetened condensed milk Teapot®	83
Sour	Citric acid 0.50gL^{-1} (R1)	13[a]	Rye bread Bolletje®	15	Buttermilk Pauls®	39
	Citric acid 0.80gL^{-1} (R2)	33[a]	Buttermilk Albert Heijn Puur en Biologisch®	38	Baby pickles Printana®	57
	Citric acid 1.50gL^{-1} (R3)	67[a]	Biogarde (yogurt) Albert Heijn home brand®	50		
			Sour pickles Albert Heijn home brand®	78	Natural yogurt Dutch Lady®	70
			Bottled lemon juice Albert Heijn home brand®	97	Bottled lemon juice Sunshine®	94
Bitter	Caffeine 0.50gL^{-1} (R1)	13[a]			Bottled unsweetened oolong tea Pokka®	15
	Caffeine 0.80gL^{-1} (R2)	33[a]			Bottled unsweetened Japanese green tea Pokka®	23
	Caffeine 1.50gL^{-1} (R3)	67[a]	Grapefruit juice Albert Heijn home brand®	57	Grapefruit juice Florida Natural®	57
			Black chocolate 85% cocoa Lindt Excellence®	70	Black chocolate 85% cocoa Lindt Excellence®	72
Umami	MSG 1.20gL^{-1} (R1)	13[b]	Non-fried natural seaweed Nori®	28	Roasted seaweed Nico-nico®	25
	MSG 3.00gL^{-1} (R2)	33[b]	Crab sticks Vici®	43	Prawn crackers Double Decker®	47
	MSG 7.00gL^{-1} (R3)	67[b]	Parmesan Cheese Grana Padano®	69	Parmesan Cheese Grana Padano®	70
			Soy Sauce Kikkoman®	86	Soy Sauce Kikkoman®	80
Salty	NaCl 2.00gL^{-1} (R1)	17[a]	Cracotte natural (crispbread) LU®	14	Jacob's low salt and hi-fiber crackers Kraft®	8
	NaCl 3.50gL^{-1} (R2)	33[a]			Cream cracker Hup Seng®	25
	NaCl 5.00gL^{-1} (R3)	57[a]	Potato chips natural Pringles®	48	Potato chips natural Pringles®	41
			Old cheese 48+ Old Amsterdam®	74	Old cheese 48+ Old Amsterdam®	64
			Soy sauce Kikkoman®	94	Soy sauce Kikkoman®	91
Fat sensation			Melba® toast	0	Original crispy rye bread Wasa®	0
			Snackcups natural round (crackers) Haust®	9	Ritz original crackers Mondelez International®	21
			Slagroomvla (cream custard) Friesland Campina®	55	Cream cheese original 60% less fat Philadelphia®	54
			Cream cheese original Philadelphia®	72	Swiss white chocolate classic Lindt®	76
			White chocolate Verkade®	73		
			Unsalted butter Friesland Campina®	97	Unsalted butter Devondale®	97

145 [a]Munoz & Civille, 1992; [b]Martin *et. al*, 2014

Panel performance

Both panels were instructed to evaluate an identical set of 19 control products in terms of six taste attributes to assess their performance. Panel performance measures (discriminative power, agreement, and reproducibility) were regularly monitored during training and profiling sessions. Oral feedback was given by the researcher to improve the panels' performance.

In general, the training procedure yielded two panels that were similar in panel performance but with a different cultural background. Both panels were able to discriminate between solutions and products, and the majority of the taste values could be reproduced. More importantly, two panels obtained similar taste profiles for a selection of 19 control foods (see **Figure 1**).

The detailed training procedure and quantitative data regarding panel performance are described in Teo et al. (under review).

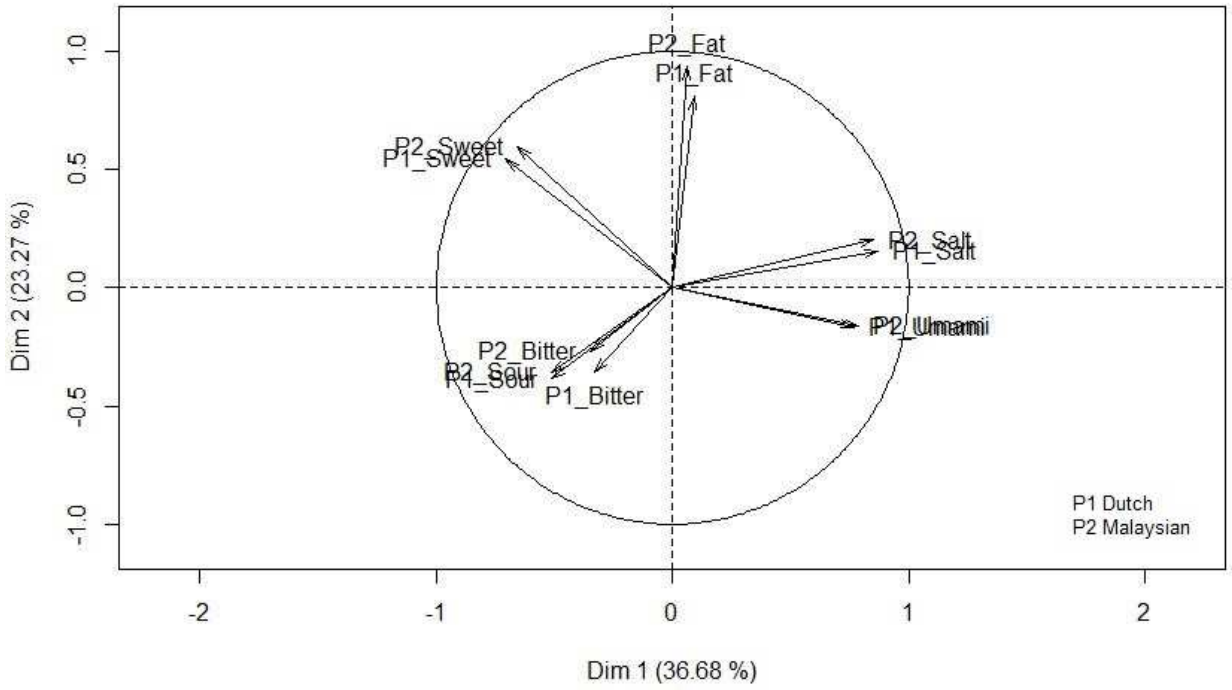

Figure 1. Taste attributes rating consistency of a total of 19 control products across two panels. P1 represents the ratings of Dutch panel, whereas P2 represents the ratings of Malaysian panel

Selection of commonly consumed foods

Dutch foods- Dutch National Food Consumption Surveys (DNFCS 2007-2010)

The commonly consumed foods were selected based on a two-day 24hour dietary recall (24hDR) data on a representative sample of 1402 Dutch adults (704 males, 698 females), aged 19-50 years (DFCNS 2007-2010) (Van Rossum, Fransen, Verkaik-Kloosterman, Buurma-Rethans, & Ocké, 2011). The mean age of the respondents was 33±9 years, with the body mass index (BMI) of 25±5 kg/m^2. These food items were selected based on several criteria, i.e. their contribution to the consumption of energy and macronutrients, as well as the consumption frequency. Single food items like raw ingredients used for cooking/ baking (e.g. oil) and condiments (e.g. ketchup) were also included in the food selection, based on how they were reported in 24hDR of Dutch dataset. This resulted in a list of 469 commonly consumed foods that contributed to 83% of energy intake, 82% of protein, 79% of fat, and 88% of carbohydrate for an average individual per day consumption. In addition, we consulted the experts (i.e. dietitian) to select one of the frequent consumed brands. Of 469 Dutch foods, 71% of them were non-cooked foods, that is those foods are readily eaten after purchased from retail stores without any preparation or heating process such as cookies, breads, cakes, and fruits; whilst 29% of them were cooked foods which need to be further prepared (i.e. minimal cooking or heating) before eaten including mixed dishes, frozen foods, sausages and instant noodles/ soups.

Malaysian foods- Malaysian Adults Nutrition Surveys (MANS 2014)

The food frequency questionnaire (FFQ) data of MANS 2014 was used to select the commonly consumed Malaysian foods (Institute for Public Health, 2014). It consisted of 165 food items.

This FFQ survey was conducted on a nationwide sample of 3000 Malaysian adults (1388 males, 1612 females), aged 18-59 years, living in Peninsular and East Malaysia. The mean age of the respondents was 38±11 years, with a BMI of 26±8 kg/m^2. In this study, a systematic approach was used for food selection. First, food items with a prevalence of consumption >20% were selected from a total of 165 items. This resulted in a preliminary list of 120 food items.

Given the simplification of food items in FFQ, it was impractical to conduct sensory testing on only 120 general food items. For example, a general food item of "leafy green vegetables" could consist of mustard leaves, water convolvulus, Chinese kale, spinach and sweet leaf bush. Therefore, we further detailed individual food items from those 120 foods based on the accessibility of foods in market, popularity of foods using a food composition database, and sensory differences due to different culinary practices. The single food items including raw ingredients for cooking (i.e. oil, chili) and condiments (i.e. fish sauce) were not considered as a single food, but prepared with other ingredients as a dish according to how they were reported in the 24hDR of MANS dataset (see sub-section *Dutch foods*). The importance of these selected foods in diets were then evaluated for their energy and macronutrients contribution, and the energy intake variations using a MANS 2014 24hDR data. This resulted in a list of 423 common foods that contributed to 88%, 85%, 90% and 88% of the average person's daily energy, protein, fat, and carbohydrate intakes, respectively. In addition, the expert knowledge (i.e. dietitian) was consulted for the most frequent consumed brands and commonly applied cooking methods. Of 423 Malaysian foods, 34% of them were non-cooked foods, i.e. readily eaten after purchased from retail stores without any preparation or heating process; whereas 66% of them were cooked foods, i.e. need to be further prepared including minimal cooking or heating before eaten.

224

225 Sample preparation and assessment

226 *Dutch food samples*

227 The selected foods were purchased at retail stores and were prepared according to the description
228 of the foods in the food composition database (e.g. fried, baked, boiled etc.), and on-pack
229 instructions. Expert knowledge was used for the standardized procedures of cooking (Henderson,
230 1999), e.g. the specific amount of water and time that was needed to boil different types of
231 vegetables.

232

233 *Malaysian food samples*

234 The selected commercially available foods were purchased at the retail stores and prepared in line
235 with the description of the foods in the database and on-pack instructions. Those purchased foods
236 were mostly ready-to-eat products (e.g. biscuits, juices) or simple foods with minimal cooking
237 efforts (e.g. cooked white rice, hard-boiled eggs). The common complex cooked dishes were
238 purchased from the food service outlets around Subang Jaya area by using a convenience
239 sampling approach. In the Malaysian setting, the approach of buying outside foods was used as
240 more than 64% outside-home food consumption was reported in Malaysian population (Poulain,
241 Tibère, Laporte, & Mognard, 2014). Prior to any purchase, a cooked dish was tasted and
242 confirmed as a common dish on the outlet's menu. The recipe was also asked from the food
243 providers.

244

245 *Sample preparation and evaluation*

The sample preparation and evaluation was similar in both countries. Each evaluation sample was prepared as approximately 15ml or 15g, and presented in a 30ml plastic cup using a standardized protocol. Samples were presented blind with random 3-digit codes and served under serving temperatures based on the norms. For example, cold foods were served at 4-9^{o}C, hot foods were served at 60-65^{o}C and others were served at room temperature of 20-25^{o}C. If foods were heterogeneous or mixed in composition (i.e. a fried rice with shrimps and vegetables), a representative portion was provided to each panelist. Panelists were instructed to consume the entire amount and rate all six taste attributes on 100-point anchored reference scales with aid of reference solutions and products (See **Table 1.**). Before and after each food item was tested, panelists neutralized their mouth with a plain cracker and by rinsing with mineral water (Evian®, Évian-les-Bains, France). All samples were evaluated under white light in sensory booths and the sensory assessments were conducted by means of EyeQuestion® software (Logic8, BV, Gelderland, The Netherlands). All samples were tested in three replicates and a maximum of nine samples were tasted in a session, where each session lasted for 1.5 hours.

Nutrient contents of selected Dutch and Malaysian foods

Dutch foods

The nutrient composition of Dutch foods was obtained from the Dutch Food Composition Table (NEVO), a database that contains information on the composition of foods and dishes eaten frequently by a large part of Dutch population (Westenbrink, Jansen-van der Vliet, Castenmiller, Grit, & Verheijen, 2016) and food product labels. Recipe calculation was used in estimating the nutrients of foods that were prepared with baking or cooking fats (e.g. fried meat) and beverages

with added milk or sugars (e.g. coffee and tea). The nutrients that were used in the analyses included: energy (kcal/100g), protein (g/100g), fat (g/100g), carbohydrates (g/100g), mono-and disaccharides (g/100g), dietary fiber (g/100g) and sodium (mg/100g).

Malaysian foods

Nutrient values of each food item were obtained from the Nutrient Composition of Malaysian foods (Tee, Noor, Azudin, & Idris, 1997), Energy and Nutrient Composition of Singaporean foods (Food composition guide Singapore, 2011) and food product labels. Recipe calculations were used to estimate the nutrient content of the complex cooked dishes and mixed beverages. The nutrients of interest in this analyses were energy (kcal/100g), protein (g/100g), fat (g/100g), carbohydrates (g/100g), mono-and disaccharides (g/100g), dietary fiber (g/100g) and sodium (mg/100g). No data of mono-and disaccharides and dietary fiber was available in the Malaysian nutrient composition database. Therefore, the total sugar content and dietary fiber of Singapore food database was used (Food composition guide Singapore, 2011). In case dietary fiber and mono- and disaccharides were not available in the Singapore food database, the USDA National Nutrient Database for Standard Reference (United States Department of Agriculture & Agricultural Research Service, 2008) was used.

Statistical analysis

A total of 469 Dutch foods and 423 Malaysian foods was included in the data analysis. Statistical analysis was performed using IBM SPSS Statistics (version 22.0, IBM Corp., Armonk, New York, USA) and a $p<0.05$ was considered significant.

A separate hierarchical cluster analysis was performed on 469 Dutch and 423 Malaysian foods to identify similar groups of food items, based on the 5 basic tastes and fat sensation intensity values. Since different food items were used from the two countries, separate cluster analysis was used for the Dutch and Malaysian database. The number of clusters was decided using Ward's method (Ward, 1963). Six Dutch and five Malaysian food taste clusters were identified, which accounted for 73% (R^2=0.73) and 70% (R^2=0.70) of the variance, respectively. The identified Dutch and Malaysian food taste clusters were further explored in biplots for validation purpose (data not shown).

Pearson's correlations were also calculated between sweet, sour, bitter, umami, salt and fat sensation. Simple linear regression analysis was performed between taste intensity rating and nutrient content separately for Dutch and Malaysian foods. The differences of taste-nutrient associations between two countries were further compared by their 95% confidence intervals on Pearson's correlation, using Fisher's z' transformation.

In addition, the biplot representations of principle component analysis (PCA) with taste attributes as active variables and nutrient content was supplementary variables was conducted for both Dutch and Malaysian foods. The PCAs were performed to visualize the relationships between the tastes and nutrient content in two countries, using statistical package R (Rstudio Inc; version 1.0.136).

A full list of the Dutch and Malaysian foods that were profiled and clustered according to taste is shown in **supplemental Table S1** and **S2**.

Results

312 Taste intensity and nutrient content of the Dutch and Malaysian foods

313 **Table 2.** shows the distribution of taste intensity of 469 selected Dutch and 423 selected
314 Malaysian foods. Both Dutch and Malaysian foods had mean taste intensity ratings below 13.3
315 point (R1) for sourness and bitterness; whereas sweetness, saltiness and fat sensation of both
316 foods were in the first third of a 100-point scale. Malaysian foods had a mean umami taste ranged
317 between R1and R2 (33.3point); whilst umami taste of Dutch foods was below R1.

318 In general, Dutch and Malaysian foods showed no significant differences in the level of
319 sweetness. Dutch foods were significantly higher in sour (11 *vs.* 7point), bitter (4 *vs.* 3point) and
320 fat sensation (31 *vs.* 24point) tastes, but lower in salt (17 *vs.* 19point) and umami (8 *vs.* 15point)
321 tastes compared to Malaysian foods. Although the mean taste intensities of foods were
322 statistically significant different between two countries, the differences were observed as smaller
323 than 7 points, on 100-point Spectrum^{TM} taste scales. With regard to nutrient content, Dutch foods
324 had higher energy density (256 *vs.* 197kcal), fat (14 *vs.* 8g) and mono- and disaccharides content
325 (13 *vs*. 9g) compared to Malaysian foods (p<0.01).

326 Of 919 total profiled foods, 54% and 46% were categorised in non-cooked and cooked foods
327 respectively. Most of the non-cooked foods were the foods from the sweet and fatty cluster, while
328 the cooked foods were mainly from the cluster of savoury and fatty. In the subgroup of non-
329 cooked foods, Dutch foods were significantly higher in salt taste (15 *vs.* 8point) and fat sensation
330 (32 *vs.* 15point) compared to Malaysian foods. Whilst, Dutch cooked foods were significantly
331 higher in bitter (6 *vs.* 2point) but lower in sweet (8 *vs.* 15point) and umami (14 *vs.* 20point) tastes
332 compared to Malaysian cooked foods.

333

Table 2. Distribution of taste intensity values and nutrient content of 469 common Dutch and 423 Malaysian foods

	Dutch foods							Malaysian foods						
	Mean	SD	0%	Q1	Median	Q3	100%	Mean	SD	0%	Q1	Median	Q3	100%
Taste intensity														
Sweet	22	20	1	6	11	39	76	20	17	1	6	13	34	72
Sour	11**	14	0	2	4	14	73	7	10	0	1	2	8	51
Bitter	4**	9	0	1	1	3	63	3	7	0	0	1	2	68
Umami	8**	11	0	1	1	14	64	15	14	0	1	13	28	48
Salt	17*	17	0	3	11	32	67	19	14	0	3	22	31	62
Fat sensation	31**	24	1	10	27	49	98	24	13	0	13	27	34	65
Nutrients (in 100g)														
Energy, kcal	256**	199	0	68	243	391	900	197	143	0	73	167	283	572
Protein, g	7	7	0	1	5	10	38	7	7	0	2	5	10	39
Fat, g	14**	19	0	0	5	21	100	8	9	0	1	6	13	55
Carbohydrates, g	25	27	0	2	12	49	98	24	23	0	6	16	37	100
Mono and disaccharides, g	13**	18	0	1	4	16	98	9	13	0	1	4	11	74
Dietary fiber, g	2	2	0	0	1	3	16	2	2	0	0	1	2	14
Sodium, mg	316	479	0	10	133	492	5630	310	345	0	37	224	469	2387

Significant different from Malaysian foods at $^{*}p<0.05$, $^{**}p<0.01$ by student-t-test

336 Dutch and Malaysian food taste clusters

337 Cluster analysis indicated six main clusters of Dutch foods and five main clusters of Malaysian
338 foods based on taste and fat sensation intensities (**Figure 2.** and **Figure 3.**). Cluster 1 (23% of
339 total Dutch foods, 19% of total Malaysian foods) included more 'sweet and fatty foods' (i.e.
340 confectionery and pastry), compared to the other clusters. Foods in this cluster had high sweet
341 taste (44-51 point) and fat sensation (27-38 point) values. Cluster 2 (14% of total Dutch foods,
342 15% of total Malaysian foods) contained foods with high 'sweet and sour' intensities (i.e. fruits
343 and soft drinks), with a mean of 32-37 point in sweetness and 20-35 point in sourness. All
344 'neutral' foods without a predominant taste, were low in all 6 taste modalities (15 point) were
345 categorized into cluster 3 (28% of total Dutch foods, 14% of total Malaysian foods). Cluster 4
346 (25% of total Dutch foods, 50% of total Malaysian foods) included more 'savory and fatty' foods,
347 which were mostly the mixed dishes and cheeses. Foods in this cluster were dominant in umami
348 (23-27 point), salt (31-42 point) and fat sensation tastes (33-47 point). The 'bitter' beverages (i.e.
349 coffee) were grouped in cluster 5 (3% of total Dutch foods, 2% of total Malaysian foods), with a
350 mean of bitter intensity 43-46 point. Cluster 6, which contained 'fatty' foods was only formed in
351 the Dutch database. A total of 7% of Dutch foods (including butter, margarine bread spread,
352 cooking fats and oils) were grouped in this cluster.

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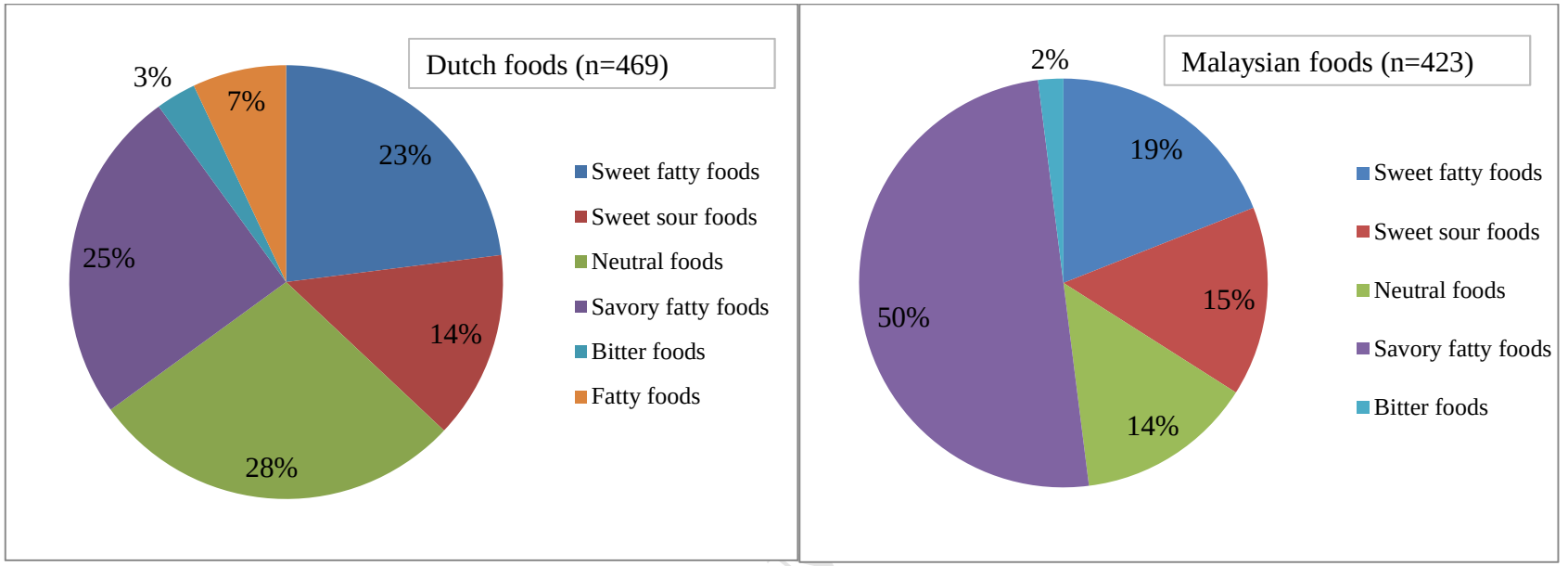


Figure 2. Proportion of each taste cluster to total i) Dutch and ii) Malaysian food items

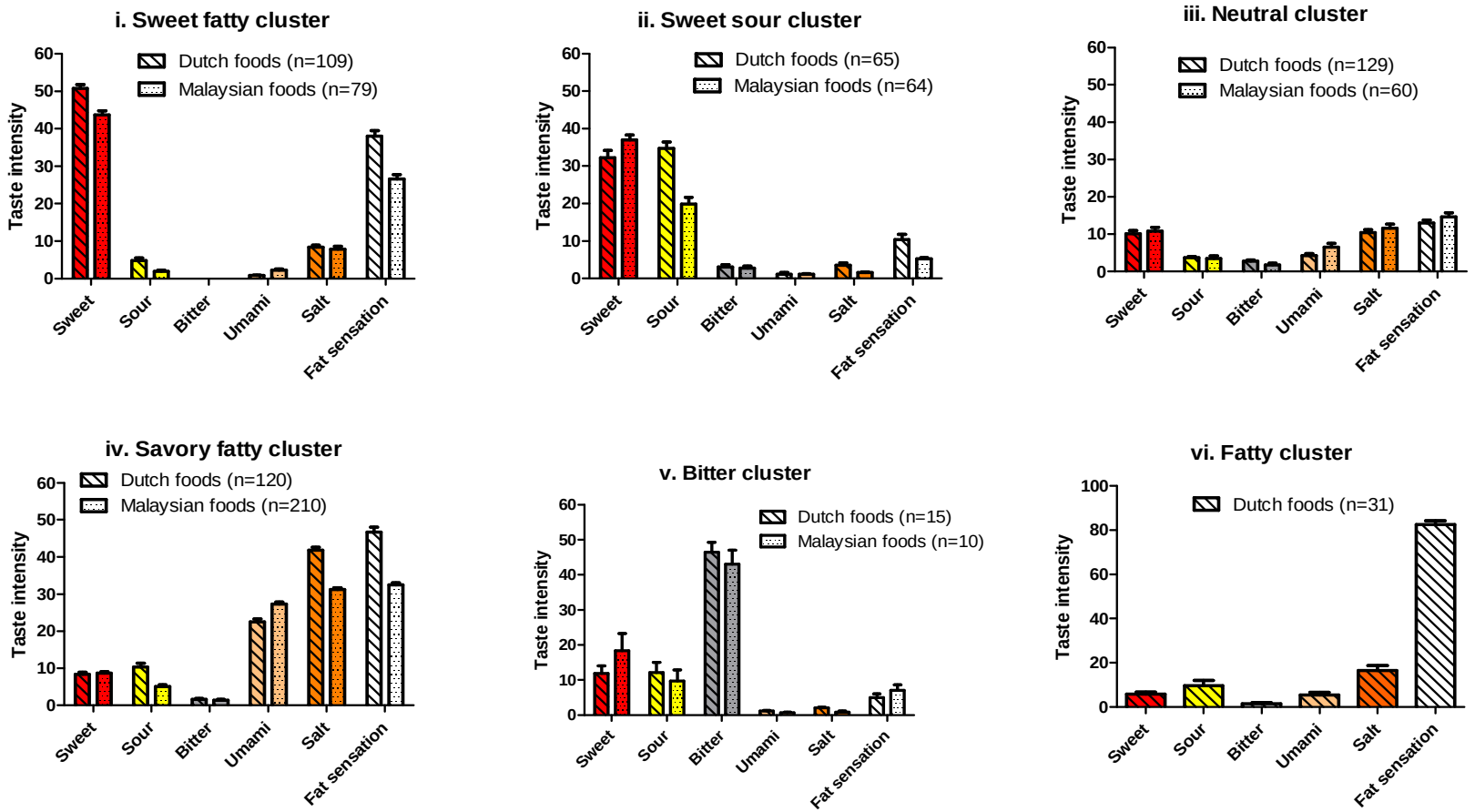


Figure 3. Mean (± standard error) taste intensity of Dutch and Malaysian foods responses to i) sweet fatty cluster, ii) sweet sour cluster, iii) Neutral cluster, iv) savory fatty cluster, v) bitter cluster, vi) fatty cluster, measured using a 100 point Spectrum™ inspired rating scales by Dutch and Malaysian trained panels

368 Association between taste intensity and nutrient content in Dutch and Malaysian foods

369 **Table 3.** and **Figure 4.** show the association between taste intensity and nutrient content in
370 commonly consumed Dutch and Malaysian foods. Sweetness of Dutch or Malaysian foods was
371 positively associated with their mono- and disaccharides and total carbohydrate content. Protein,
372 fat and sodium content, to a smaller extent, were negatively associated with a Dutch or Malaysian
373 food's sweet taste. Whilst, dietary fiber and energy (only marginally significant in Dutch foods)
374 were not associated with sweet taste. Sweetness was best explained by its mono- and
375 disaccharides content in Dutch (β=0.89, p<0.001, R^2=0.67) and Malaysian foods (β=0.78,
376 p<0.001, R^2=0.38).

377 Umami taste was positively associated most highly with its protein content in both Dutch (β=0.8,
378 p<0.001, R^2= 0.29) and Malaysian foods (β=1.0, p<0.001, R^2=0.26), followed by sodium and fat
379 contents. In contrast, carbohydrate, and mono- and disaccharides contents were inversely
380 associated with a food's umami taste. Energy was not associated with umami taste.

381 In both Dutch and Malaysian foods, saltiness was positively associated with sodium, protein, fat
382 and energy content, but negatively associated with carbohydrate and mono- and disaccharides
383 content. No association was found between saltiness and dietary fiber. Saltiness was best
384 explained by a food's sodium content in both the Dutch (β=0.02, p<0.001, R^2= 0.48) and the
385 Malaysian settings (β=0.02, p<0.001, R^2=0.27).

386 A food's perceived fat sensation was reported to be most strongly associated with its fat content,
387 in both Dutch (β=0.93, p<0.001, R^2= 0.56) and Malaysian setting (β=0.62, p<0.001, R^2=0.17). To
388 a lesser extent, fat sensation was also positively associated with its energy, protein and sodium
389 contents. An inverse association was found between fat sensation and its carbohydrate content.

Sour and bitter tastes were reported negatively associated with energy and most of the macronutrient contents in both Dutch and Malaysian foods.

Associations of taste intensity and nutrient content were not different between the different countries, except the fat sensation and its fat content (**Figure 4.**). Fat sensation of a Dutch food was found to be stronger associated with its fat content (r=0.76, CI 0.86-1.0) compared to a Malaysian food (r=0.42, CI 0.51-0.78), in a linear regression model.

Table 3. Pearson correlation between taste and nutrients across Dutch and Malaysian food items

	Energy	Protein	Fat	Carbohydrates	Mono and disaccharides	Dietary fiber	sodium
i. Dutch							
Sweet	0.11*	-0.36	-0.14	0.54[ab]	0.82[ab]	0.03	-0.27[a]
Sour	-0.36	-0.20	-0.19	-0.31[ab]	-0.12[a]	-0.29[a]	-0.03[a]
Bitter	-0.20	-0.19	-0.12	-0.16	-0.07	-0.04	-0.13
Umami	-0.004	0.54	0.12[a]	-0.32	-0.37	-0.21[a]	0.58[a]
Salt	0.22	0.55	0.25[a]	-0.13[a]	-0.30[a]	-0.08	0.69[ab]
Fat sensation	0.58[ab]	0.24[a]	0.75[ab]	-0.18	-0.04[a]	-0.28[ab]	0.20
ii. Malaysian							
Sweet	0.04	-0.37	-0.17	0.33	0.62	-0.04	-0.41
Sour	-0.24	-0.18	-0.28	-0.07	0.07	-0.02	-0.14
Bitter	-0.20	-0.16	-0.15	-0.16	-0.05	-0.12*	-0.10*
Umami	0.04	0.51	0.27	-0.32	-0.45	-0.05	0.47
Salt	0.16	0.52	0.39	-0.24	-0.46	0.02	0.52
Fat sensation	0.26	0.43	0.42	-0.10*	-0.17	-0.01	0.20

All correlations (2-tailed) are significant at, *$p<0.05$, $p<0.01$, except sweet with dietary fiber, bitter with mono and disaccharides, umami with energy, salt with dietary fiber for both Dutch and Malaysian foods; sour with sodium, bitter with dietary fiber, fat sensation with mono and disaccharides for Dutch foods; sweet with energy, sour with carbohydrates, mono and disaccharides and dietary fiber, umami with dietary fiber, fat sensation with dietary fiber for Malaysian foods

[a]Different from Malaysian foods by comparing the 95% confidence interval

[b]Different from Malaysian foods by comparing the 99% confidence interval

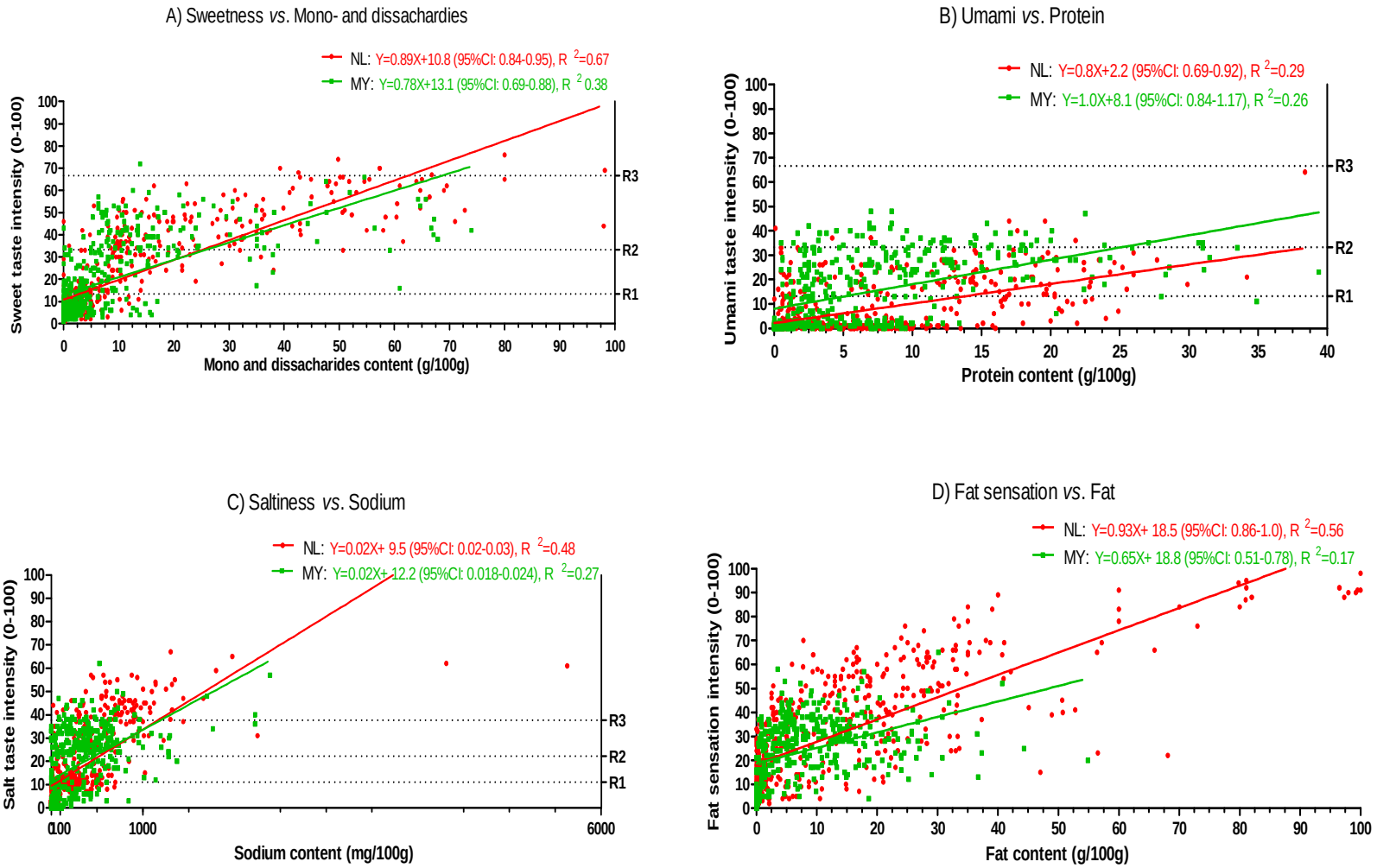
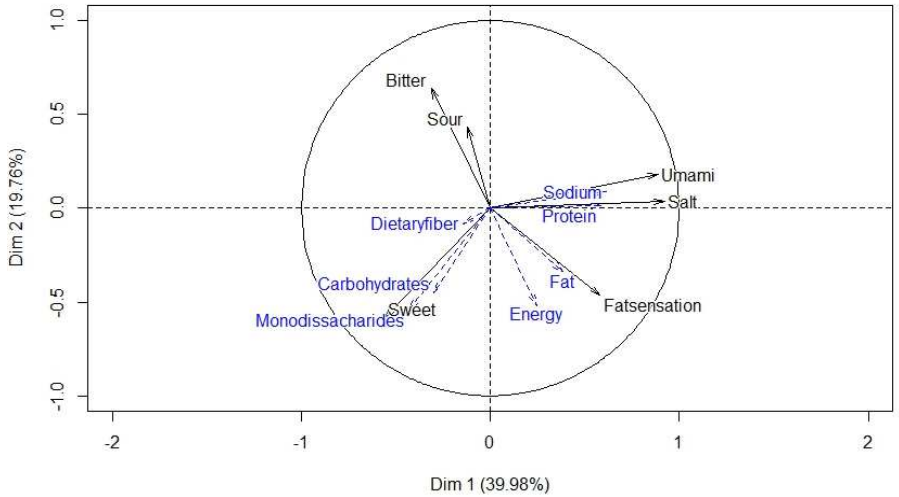


Figure 4. The associations between A) Sweet vs Mono and disaccharides, B) Umami vs protein, C) Saltiness vs sodium, D) Fat sensation vs Fat in Dutch and Malaysian foods. Red dot represents Dutch foods, whereas green dot represents Malaysian foods

Figure 5. shows the biplot representations of the PCA with taste intensities as active variables and nutrient content as supplementary variables for both Dutch and Malaysian foods. As can be seen from the figures, similar taste and nutrient relationships were found in Dutch and Malaysian foods. The first component explained most of the variation, that is 40% in Dutch foods, and 50% in Malaysian foods. It was characterized by all tastes and related to all nutrients, except bitter, sour and dietary fiber. The second component (20% in Dutch foods, 19% in Malaysian foods) was determined by sweet, bitter and sour tastes and related to mono- and disaccharides and carbohydrates. Bitter and sour were mainly differentiated by the 3rd component (data not shown). The position of dietary fiber was close to the origin, indicating that it does not contribute much to the taste space.

Similarly, Pearson's correlations between tastes showed that saltiness, umami and fat sensation were positively correlated with one another, but negatively correlated to sweetness in both Dutch and Malaysian foods (all $p<0.01$) (data not shown).

439 i. Dutch foods



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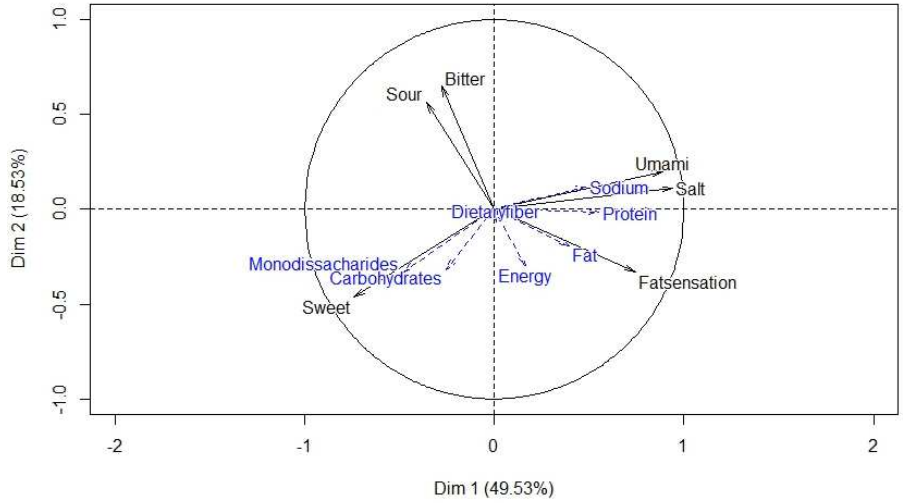
441 ii. Malaysian foods

442



443

444 **Figure 5.** Biplot representations from covariance PCA of i) 469 Dutch and ii) 423 Malaysian foods means

Discussion

This present study aimed to investigate the association between taste intensity and nutrient content in commonly consumed Dutch and Malaysian foods. As hypothesized, a positive association was found between sweetness and mono- and disaccharides, between umami and protein, between saltiness and sodium and between fat sensation and fat content. Energy content was positively associated with saltiness and fat sensation in both Dutch and Malaysian foods, but only marginally associated with sweetness of a Dutch food. The associations of taste intensity and nutrient content were not different between the different countries, except fat sensation and fat content. The basic taste-nutrient space was found as universal between commonly consumed Dutch and Malaysian foods.

Our findings are in agreement with earlier studies in the Netherlands (van Dongen, et al., 2012), Australia (Lease, et al., 2016) and the United States (van Langeveld, et al., 2017), all of which found that sweetness was positively associated with mono- and disaccharides, and salt and umami taste intensity were both positively associated with sodium and protein content. Moreover, in current study, energy content was found to be associated with salt, umami and fat sensation, but not sweet taste. These results are in line with the previous works of Lease et al. (2016). They could be explained by the fact that energy density of foods is largely determined by their water and fat content (Drewnowski, 1998). Fat content was found positively correlated with saltiness, umami and fat sensation, but negatively correlated to sweetness.

Similar associations of taste intensity and nutrient content were found in Dutch and Malaysian foods, except the fat sensation and its fat content. Fat sensation of a Dutch food was stronger associated with its fat content compared to a Malaysian food. Also, a fat taste cluster was formed

467 in Dutch foods but not in Malaysian foods. In current study, we used two different approaches in
468 profiling fat products (i.e. butter, margarine, oils) in each country, that is according to how they
469 were recorded in their local 24hDR dataset. For example, 100% oil, was tested separately as a
470 single food in The Netherlands, whereas oil was prepared with other ingredients within a dish in
471 Malaysia setting. The perceived range of fat sensation intensities was higher in Dutch foods (1-98
472 point) than in Malaysian foods (0- 65 point). And thus, by profiling fat products as a mixed dish,
473 it possibly resulted in a weaker association of fat sensation and its fat content in Malaysian foods,
474 as it may be suppressed by other tastes.

475 Another important finding was that the similar basic taste-nutrient space was found in both
476 commonly consumed 469 Dutch and 423 Malaysian foods by comparing the taste-nutrient PCAs.
477 In a total of 892 food items, we observed that only 3 identical commercially available products
478 were tasted in both Dutch and Malaysian taste databases. These products were carbonated drink
479 Coca-Cola® (regular), chocolate candy M&M's® (with peanuts) and chocolate bar KitKat®
480 (natural). Hence, in broad terms, the basic taste-nutrient space across two countries remained
481 similar, even though analysis were performed on a wide variety of Dutch and Malaysian foods. A
482 similar taste PCA observation was also reported in a recent paper of Dijon group in 2014 on 590
483 French foods (Martin, et al., 2014). Taken together, this indicates that the basic taste-nutrient
484 space of commonly consumed foods around the world may be universal, without taking
485 considerations of texture, flavors and odors.

486 It is remarkable to note that the average taste profiles of commonly consumed foods as observed
487 for the Netherlands and Malaysia are in some aspects very similar to the taste profiles of foods in
488 France (Martin, et al., 2014) and Australia (Lease, et al., 2016), which also used the 100-point
489 Spectrum^{TM} scales. For example, the average perceived saltiness intensity in the Dutch (17-point)

and Malaysian (19-point) foods are almost equal to those in French (19-point) and Australian (17-point) foods. However, the average sweetness intensity in Australian foods (28-point) is higher than those in the Dutch (22-point), Malaysian (20-point) and French (17-point) foods. These discrepancies could be explained by the tested foods in the study of Lease et al (2016) were aimed for Australian children, aged 2-16 years. In which, previous studies have suggested that younger children heightened preference for sweet than did adolescents, and adolescents likewise had a higher sweet preference than did adults (de Graaf & Zandstra, 1999; Desor & Beauchamp, 1987).

On the other hand, average umami taste intensity in Malaysian foods is higher (15-point) compared to the foods in the Netherlands (8-point), France (8-point) and Australia (8-point). These differences are likely to be related to food pattern variations in the different cultural contexts. Asian foods are found to contain ingredients with high amounts of umami substances (i.e., fermented and dried seafood, mushrooms, beans and grains), and to undergo preparations that enhance the release of umami substances by adding fish sauce or soy sauce (Hajeb & Jinap, 2015). It is further supported by the findings of high free glutamic acid content in local Malaysian condiments, which are commonly used in routine cooking. For instance, fish sauce (*Budu*), shrimp paste (*Belacan*), fermented soy bean paste (*Taucu*) and soy sauce are rich in umami, with a free glutamic acid of 948- 4207mg per 100g (Jinap, et al., 2010; Khairunnisak, Azizah, Jinap, & Nurul Izzah, 2009). In present study, a higher amount of ‘savory fatty’ dishes were reported in commonly consumed Malaysian foods than Dutch foods. Therefore, we also expected a higher umami taste in Malaysian foods compared to Dutch foods.

The present study were set up in controlled sensory laboratories in both the Netherlands and Malaysia, which could be differed than the natural food eating environment. Nevertheless, the

natural eating behaviors (including textural eating rate and bite sizes) of our trained panels were not standardized or controlled, in which they were encouraged to follow their own eating habits in each taste evaluation sessions. Thus, it is conceivable that our food taste profiles were adequately reflected the real eating taste perception of a population compared to hedonic taste liking of consumers, and thus it can be further translated into a population's taste database.

Conclusions

Our findings suggest that sweetness, umami, saltiness and fat sensation can signal the presence of nutrients, in particular mono- and disaccharides, protein, sodium and fat content in commonly consumed Dutch and Malaysian foods. The associations of taste intensity and nutrient content were not different between the different countries, except the fat sensation and its fat content. Basic taste-nutrient space was found as universal between commonly consumed Dutch and Malaysian foods.

The results of this work demonstrated that the Dutch and Malaysian food taste databases, complied by two equally-trained panels, allowed a valid comparison of taste intensity and nutrient content relationships in both settings. Since the food selections were based on the nationwide food consumption surveys in both countries, the associations between taste intensity and nutrient content can be generalized to foods that are eaten on a daily basis in The Netherlands and Malaysia. Further research should combine the taste databases with consumption data to better understand the taste intake patterns in general population diet.

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Conflict of interest

None of the authors reported a conflict of interest related to the study.

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Supplemental files

Table S1. Taste database of 469 Dutch foods. For each food evaluated: Cluster (result of taste classification), number of evaluations (n), mean (m) and standard error (SE) for the five basic tastes and fat sensation

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Almond paste filled tarts average	Sweet Fatty	12	56	3	1	1	2	1	1	1	9	3	37	3
Apple pie Dutch with shortbread with margarine	Sweet Fatty	10	54	3	14	3	1	0	2	1	11	3	47	4
Apple sauce tinned	Sweet Sour	12	46	4	21	2	0	0	2	1	2	1	13	3
Apple turnover	Sweet Fatty	8	62	5	6	2	1	0	1	0	12	4	33	6
Apple with skin average	Sweet Sour	12	22	3	40	4	1	0	1	1	1	0	3	1
Apple without skin average	Sweet Sour	12	20	3	38	3	2	1	0	0	1	0	4	1
Bacon lean smoked fried in non-stick coating pan	Savory fatty	7	6	3	6	2	0	0	15	5	67	3	61	7
Bacon rasher fried in non-stick coating pan	Fatty	9	4	2	3	2	4	4	9	3	21	4	61	6
Bacon rashers streaky	Savory fatty	7	4	2	6	4	0	0	21	8	53	4	76	4
Baguette brown	Neutral	9	6	2	2	1	1	1	0	0	17	2	10	2
Baguette white	Neutral	12	8	1	3	1	1	0	0	0	18	3	12	2
Banana	Neutral	12	29	2	2	1	1	1	1	0	1	1	24	5
Bean sprouts boiled	Neutral	7	8	3	6	3	11	3	3	1	2	1	6	4
Beans baked in tomato sauce tinned	Neutral	9	18	2	6	2	1	1	16	4	28	5	17	2
Beans brown tinned	Neutral	9	8	2	1	0	2	1	9	2	19	3	13	3
Beans French boiled	Neutral	10	9	1	3	2	2	1	4	2	4	1	9	3
Beans French tinned	Neutral	7	7	3	3	2	3	2	6	3	14	3	11	4
Beef olives raw	Savory fatty	10	6	2	8	2	1	0	19	6	47	5	55	6
Beef rump steak (pan-fried)	Neutral	10	5	1	7	2	1	0	18	5	17	4	24	2
Beef smoke-dried	Savory fatty	12	2	1	8	2	0	0	19	4	59	4	38	6
Beef steak tartare (pan-fried)	Neutral	10	4	1	5	2	1	0	10	3	15	2	31	5

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Beef steak tartare spiced filet americ	Savory fatty	9	8	2	5	2	0	0	19	7	41	2	51	5
Beer >7 vol% alcohol	Bitter	13	7	2	20	6	53	5	2	1	2	1	1	1
Beer pilsner	Bitter	13	6	1	17	6	55	6	1	1	1	1	1	1
Biscuit brown/wholemeal	Neutral	12	24	2	1	1	1	1	0	0	10	3	8	1
Biscuit chocolate	Sweet Fatty	8	35	3	1	1	8	3	0	0	13	4	23	3
Biscuit chocolate coated Chocoprins	Sweet Fatty	7	59	3	1	0	4	2	1	0	13	5	41	3
Biscuit Dutch Amaretti Bitterkoekjes	Sweet Fatty	9	50	5	1	0	12	5	1	1	10	4	27	5
Biscuit Dutch shortbread spritsstukken	Sweet Fatty	8	38	2	1	1	1	1	0	0	15	4	27	6
Biscuit filled Prince	Sweet Fatty	7	47	3	1	1	0	0	0	0	13	5	24	4
Biscuit fortified with currants LigaEvergreen	Neutral	8	36	3	3	2	1	0	1	1	13	3	11	2
Biscuit fortified Liga Fruitkick	Sweet Sour	9	33	2	18	3	0	0	0	0	10	4	16	2
Biscuit fortified Liga Milkbreak	Sweet Fatty	8	36	2	2	2	1	1	1	0	14	4	20	3
Biscuit fruit	Neutral	12	30	2	5	1	1	0	1	0	7	2	12	2
Biscuit salted average	Neutral	12	6	2	1	1	0	0	4	2	45	2	17	3
Biscuit savory Sultana	Savory fatty	7	10	3	4	2	1	0	24	9	42	4	15	3
Biscuit shortbread Bastogne	Sweet Fatty	8	51	4	0	0	3	2	2	1	11	5	23	4
Biscuit spiced Speculaas	Sweet Fatty	11	39	3	1	1	1	1	1	0	11	3	13	3
Biscuit spiced Speculaas with almond paste	Sweet Fatty	6	60	4	1	1	3	2	0	0	15	6	47	6
Biscuit sponge fingers	Sweet Fatty	9	51	4	0	0	0	0	0	0	7	3	11	3
Biscuit sweet	Neutral	12	24	1	1	0	0	0	0	0	8	2	8	1
Biscuits & snacks cheesy averaged	Savory fatty	8	6	2	2	1	0	0	8	4	41	4	24	4
Biscuits averaged	Neutral	11	27	3	1	1	1	0	1	0	11	3	12	2
Biscuits Dutch krakeling	Sweet Fatty	8	53	3	0	0	0	0	0	0	11	4	24	5
Boiled sweets	Sweet Sour	12	46	3	19	4	2	1	0	0	2	1	7	3
Bread Blue Band Goede Start white bread	Neutral	11	5	1	2	1	1	1	0	0	11	2	9	2
Bread brown wheat	Neutral	11	4	1	2	1	2	1	0	0	12	2	8	1
Bread ciabatta no filling (warm)	Neutral	8	6	1	3	1	1	1	1	1	18	2	8	1
Bread corn with sunflower seeds	Neutral	11	7	2	1	1	1	1	1	1	11	3	11	3
Bread multigrain average with seeds	Neutral	11	4	1	2	1	2	1	1	0	13	2	9	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Bread pita white (warm)	Neutral	10	7	2	2	1	1	0	3	2	13	3	14	3
Bread stuffed Bapao meat	Savory fatty	9	18	2	6	2	0	0	25	9	35	5	36	4
Bread Tijger white	Neutral	10	7	2	2	1	1	1	0	0	13	3	12	4
Bread wheat malt Tarvo	Neutral	10	5	1	3	1	2	1	0	0	12	3	8	2
Bread white milk based	Neutral	11	7	2	2	1	0	0	0	0	11	2	12	2
Bread white Turkish (warm)	Neutral	9	5	1	2	1	1	1	1	0	14	2	11	2
Bread white water based	Neutral	11	5	1	2	1	2	1	0	0	11	2	9	2
Bread white with sugar Suikerbrood	Sweet Fatty	11	51	4	3	2	1	1	0	0	12	3	37	6
Bread wholemeal average	Neutral	11	4	1	3	1	2	1	1	0	11	2	7	1
Bread wholemeal with seeds	Neutral	10	5	2	5	2	4	2	1	1	14	3	9	3
Bread wholemeal with sunflower seeds	Neutral	11	4	1	2	1	4	2	1	1	14	2	9	2
Breadsticks	Neutral	8	5	1	1	0	1	0	0	0	20	2	5	1
Breakfast cereal All-Bran Fruit and Fibre	Neutral	11	19	2	2	1	1	1	1	0	10	2	5	1
Breakfast cereal Brinta prepared with semi-skimmed milk	Neutral	7	6	2	1	1	2	1	1	1	6	2	20	5
Breakfast cereal Cornflakes Kellogg's	Neutral	12	14	2	2	1	1	1	2	1	9	2	5	1
Breakfast drink Goede Morgen original	Sweet Sour	9	30	4	24	2	1	1	1	1	3	2	30	3
Breakfast drink HeroFruitontbijt p 100ml	Sweet Sour	8	39	4	32	3	1	0	0	0	2	2	11	3
Breakfast prod Coco Pops Kellogg's	Sweet Fatty	8	41	4	1	0	5	2	0	0	12	4	13	4
Broccoli boiled	Neutral	10	6	1	5	2	4	1	6	2	4	1	8	3
Brussel sprouts boiled	Neutral	9	8	2	2	1	19	4	9	4	5	2	7	2
Bun currant/raisin	Neutral	12	26	3	7	2	2	1	1	0	11	2	18	3
Bun wholemeal with muesli	Neutral	11	23	3	6	2	1	0	1	1	12	3	14	2
Butter salted	Fatty	8	3	2	1	1	0	0	2	2	32	3	92	2
Butter unsalted	Fatty	7	3	2	1	1	0	0	1	1	4	2	95	1
Buttermilk	Sweet Sour	12	6	1	37	1	1	1	2	1	5	3	24	3
Cabbage oxheart boiled	Neutral	7	3	1	3	2	6	2	1	0	1	0	6	4
Cabbage red with apple pieces frozen boiled	Neutral	9	24	3	10	2	4	2	10	3	15	4	12	3
Cabbage sauerkraut cooked	Sweet Sour	7	6	4	70	2	4	2	2	1	17	7	4	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Cake butter Dutch Boterkoek	Sweet Fatty	8	52	3	2	1	0	0	0	0	18	5	58	7
Cake chocolate made with butter	Sweet Fatty	8	44	3	1	0	9	4	0	0	11	4	40	3
Cake chocolate made without butter	Sweet Fatty	9	39	3	1	0	3	2	1	0	7	3	29	5
Cake Dutch spiced Ontbijtkoek	Sweet Fatty	11	42	4	2	1	5	1	1	1	8	3	22	4
Cake Dutch spiced Ontbijtkoek with raisin	Sweet Fatty	11	45	4	6	2	5	2	1	0	10	3	31	4
Cake Dutch spiced Ontbijtkoek wholemeal	Sweet Fatty	7	41	6	1	1	2	1	1	1	9	4	17	5
Cake Dutchspiced Ontbijtkoek with rockcandy	Sweet Fatty	8	52	6	1	1	3	1	3	2	11	4	21	4
Cake raisins-	Sweet Fatty	8	46	2	1	1	0	0	0	0	11	4	44	5
Cake sponge Dutch Eierkoek	Sweet Fatty	10	38	3	1	0	1	0	1	1	7	3	18	4
Cake wrapped in marzipan and chocolate	Sweet Fatty	9	70	3	2	1	6	3	1	1	5	2	56	5
Candybar KitKat	Sweet Fatty	8	59	4	1	1	3	1	0	0	12	4	47	4
Candybar Lion	Sweet Fatty	7	59	4	1	1	2	1	0	0	13	5	42	3
Candybar Mars	Sweet Fatty	12	64	4	3	1	4	1	1	0	10	4	57	5
Candybar Milky Way	Sweet Fatty	11	67	3	3	1	4	1	0	0	10	3	65	4
Candybar Snickers	Sweet Fatty	9	62	3	1	0	2	1	2	1	15	4	60	4
Candybar Twix	Sweet Fatty	9	64	4	0	0	2	1	0	0	10	4	47	4
Carrots boiled average	Neutral	10	15	2	2	1	1	1	3	2	2	1	10	3
Carrots raw average	Neutral	10	15	2	4	2	2	1	2	1	2	1	4	2
Carrots tinned	Neutral	7	15	1	2	1	2	1	3	1	10	3	11	3
Cashew nuts unsalted	Neutral	7	10	2	1	1	1	0	11	4	14	4	39	8
Cassave crackers	Savory fatty	9	15	3	1	1	1	0	19	3	31	4	29	5
Cauliflower boiled	Neutral	10	6	1	4	2	3	1	4	2	3	1	11	4
Celeriac boiled	Neutral	7	12	2	3	2	3	1	3	1	3	2	11	5
Cheese 20+	Savory fatty	8	5	2	14	5	1	1	21	7	39	6	55	5
Cheese 30+	Savory fatty	12	7	2	16	4	2	1	18	6	40	4	46	3
Cheese Brie 60+	Savory fatty	7	4	1	11	4	13	6	14	7	38	4	68	3
Cheese cream soft Boursin	Savory fatty	8	8	3	32	5	2	2	12	5	40	7	69	1
Cheese cream soft Mon Chou	Fatty	8	7	2	15	3	1	1	4	2	21	4	79	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Cheese cream soft Paturain	Savory fatty	11	6	2	27	6	1	1	17	5	50	6	65	3
Cheese Edam 40+	Savory fatty	12	4	1	21	5	3	1	16	6	45	5	50	4
Cheese goat fresh	Savory fatty	8	5	2	45	7	1	1	11	6	32	6	61	6
Cheese goat hard	Savory fatty	8	9	3	22	6	2	1	24	10	37	7	62	5
Cheese Gouda 48+ average	Savory fatty	12	6	2	18	5	1	0	17	6	41	4	51	4
Cheese Leerdammer/Maasdammer 45+	Savory fatty	12	6	1	10	3	2	1	28	7	29	4	50	5
Cheese Mozzarella	Neutral	7	2	1	7	2	1	1	3	2	9	3	40	9
Cheese sheep fresh	Savory fatty	7	4	2	10	5	1	1	44	10	38	5	53	6
Cheese spread 20+	Savory fatty	8	4	2	14	4	5	3	30	7	41	7	70	2
Cheese spread 48+	Savory fatty	7	6	2	22	5	5	3	18	7	55	6	67	4
Chewing gum without sugar	Neutral	12	29	3	2	1	2	1	0	0	1	1	4	2
Chicken cordon bleu (pan-fried)	Savory fatty	7	5	3	7	4	1	1	28	8	46	5	60	6
Chicken fillet (pan-fried)	Neutral	9	6	2	7	3	1	0	13	5	18	3	29	4
Chicken nuggets prepared in oven	Savoury fatty	7	7	3	3	2	1	1	21	6	35	3	49	5
Chicken schnitzel (pan-fried)	Savory fatty	7	6	2	2	1	1	1	13	3	35	3	42	6
Chicory boiled	Neutral	9	5	1	1	0	11	2	1	0	2	1	7	2
Chines noodle ball (deep-fried)	Savory fatty	7	9	3	3	2	1	1	37	9	45	4	54	6
Chips pre-fried (deep-fried)	Neutral	9	9	3	3	2	0	0	7	2	15	2	42	6
Chocolate bar milk with nuts	Sweet Fatty	10	65	3	2	1	3	1	5	3	11	3	64	3
Chocolate chip cookie	Sweet Fatty	7	47	3	0	0	4	2	0	0	13	6	29	4
Chocolate confetti milk	Sweet Fatty	8	60	4	1	1	3	1	0	0	6	3	34	7
Chocolate confetti mix white and plain	Sweet Fatty	8	56	7	1	1	4	2	0	0	6	4	37	6
Chocolate confetti plain	Sweet Fatty	8	54	6	1	1	6	2	0	0	6	3	35	5
Chocolate eclair	Sweet Fatty	13	56	3	3	2	5	2	1	0	9	2	62	3
Chocolate flakes milk	Sweet Fatty	8	60	5	1	1	6	3	0	0	3	2	34	6
Chocolate flakes plain	Sweet Fatty	8	52	6	0	0	10	4	0	0	6	4	37	8
Chocolate milk	Sweet Fatty	12	55	5	1	1	5	2	0	0	7	3	66	1
Chocolate plain	Sweet Fatty	10	44	5	6	4	39	7	1	1	4	2	58	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Chocolate plain with nuts	Sweet Fatty	8	38	4	1	1	31	6	2	2	8	3	57	4
Chocolate pudding with sauce	Sweet Fatty	8	42	4	1	1	9	3	0	0	5	3	48	3
Chocolates filled/Belguim chocolate	Sweet Fatty	11	64	3	1	1	7	2	0	0	6	3	66	2
Cocktail snacks based on corn or wheat	Savory fatty	10	12	3	8	4	1	0	37	8	55	2	49	4
Cocktail snacks Nibbits	Savory fatty	7	7	2	3	2	0	0	26	6	42	4	39	7
Cod boiled	Neutral	8	2	1	3	1	2	1	12	4	13	2	20	4
Coffee cappuccino instant prepared	Bitter	11	8	2	9	3	44	4	1	1	2	1	8	4
Coffee creamer full fat, with coffee	Bitter	11	6	2	8	3	54	4	1	1	2	1	7	3
Coffee creamer half fat, with coffee	Bitter	9	4	2	6	2	60	3	1	0	3	2	7	3
Coffee creamer powder, with coffee	Bitter	11	3	1	5	2	59	4	0	0	2	2	7	3
Coffee prepared	Bitter	11	2	1	9	3	63	2	1	0	3	2	4	2
Coffee with sugar and milk, vending machine	Bitter	10	26	3	10	4	36	7	1	0	3	2	18	6
Colored confetti fruit-flavored	Sweet Fatty	8	69	2	3	2	0	0	0	0	3	3	12	4
Cooking fat liquid 97%fat <17g salt unsalted	Fatty	11	8	3	5	3	1	0	10	5	32	5	88	4
Cooking fat liquid 97% fat <17 g salt	Fatty	11	8	3	8	4	1	0	23	6	56	5	90	2
Cooking fat solid 97% fat >17 g salt	Fatty	11	5	2	3	1	1	0	16	6	19	4	92	3
Corned beef	Savory fatty	7	4	2	8	3	1	0	23	8	43	4	44	9
Courgettes boiled	Neutral	9	7	1	1	0	2	1	4	2	2	1	9	3
Crackers cream	Neutral	9	5	2	1	0	1	0	1	0	8	1	7	1
Cream slice Dutch Tompouce	Sweet Fatty	8	54	4	2	1	0	0	1	1	4	2	40	3
Cream whipped with added sugar	Sweet Fatty	12	49	3	2	1	0	0	1	0	2	1	51	4
Creme fraiche	Fatty	9	4	1	33	2	1	0	2	1	8	3	64	3
Crispbakes Dutch	Neutral	12	12	2	2	1	1	0	1	0	9	2	4	1
Crispbakes Dutch wholemeal	Neutral	12	11	1	2	1	1	0	1	0	10	2	4	1
Crispbread sesame	Neutral	8	5	2	1	0	1	0	0	0	15	2	4	1
Crispbread wholemeal	Neutral	11	5	1	4	1	4	1	1	1	11	2	2	1
Crisps maize Bugles	Savory fatty	7	13	4	3	2	0	0	19	4	46	2	30	4
Crisps potato average	Savory fatty	11	11	3	5	2	1	0	17	5	43	3	30	6

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Crisps potato flavored	Savory fatty	8	11	3	7	3	1	0	26	6	47	6	40	6
Crisps potato Lays Sensations flavored	Savory fatty	9	12	2	4	2	0	0	14	3	54	3	38	8
Crisps potato light flavored	Savory fatty	7	12	4	7	3	0	0	17	4	47	5	44	9
Crisps potato light unflavored	Savory fatty	9	8	2	2	1	0	0	6	2	57	1	40	7
Crisps potato unflavored	Savory fatty	12	4	1	4	2	1	1	8	2	48	2	25	5
Crisps tortilla unflavored	Neutral	9	5	2	1	1	1	0	4	2	29	4	21	6
Croissant average	Neutral	8	13	3	2	1	1	1	1	0	19	2	35	6
Croissant with ham and cheese	Savory fatty	8	10	3	4	2	1	1	16	7	38	6	43	7
Croquette meat ragout frozen (deep-fried)	Savory fatty	9	9	3	6	2	1	0	25	7	44	5	63	5
Cucumber with skin raw	Neutral	11	6	1	4	1	4	1	1	1	1	0	3	1
Cucumber without skin raw	Neutral	11	7	1	2	1	2	1	1	0	1	0	2	1
Cupcake iced	Sweet Fatty	10	70	2	2	1	1	0	0	0	8	3	38	5
Custard chocolate full fat	Sweet Fatty	9	34	1	1	1	6	2	1	1	4	2	40	2
Custard several flavors full fat	Sweet Fatty	12	36	3	3	1	8	2	1	0	4	2	42	3
Custard soft & airy Campina	Sweet Fatty	8	42	3	0	0	0	0	1	1	4	2	49	3
Custard vanilla full fat	Sweet Fatty	12	33	1	3	1	1	0	1	0	2	1	39	3
Dairy dr Milk&Fruit strawberry-cherry	Sweet Sour	8	31	3	26	3	2	2	1	1	5	2	20	4
Dairy drink Campina fruitmilk	Sweet Fatty	8	35	1	1	1	0	0	2	2	4	2	18	2
Dairy spread plain/herbs	Fatty	12	9	3	20	5	1	0	19	6	30	4	71	1
Dates fresh	Sweet Fatty	8	46	4	3	3	0	0	1	1	2	1	19	2
Doughnuts plain	Sweet Fatty	8	44	4	1	1	1	0	1	1	12	4	49	4
Duck whole fried in non-stick coating pan	Savory fatty	7	4	2	7	2	2	1	27	9	16	3	37	8
Eclair with whipped cream filling	Sweet Fatty	8	44	2	1	1	0	0	1	1	8	3	47	5
Eggs chicken boiled average	Neutral	12	5	1	2	1	1	0	8	3	10	1	26	5
Endive boiled	Neutral	9	3	1	1	0	8	2	2	2	1	1	6	2
Endive raw	Neutral	9	4	1	1	0	10	2	1	0	1	1	2	1
Energy drink Golden Power/Bullit	Sweet Sour	8	42	7	33	5	5	2	0	0	2	1	1	1
Energy drink Red Bull/Euroshopper/Rodeo	Sweet Sour	9	55	5	39	6	10	4	0	0	3	2	4	1

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Fish fingers fried	Savory fatty	8	6	2	4	2	1	0	23	5	41	4	51	5
Flan apple and crumble topping	Sweet Fatty	11	49	3	15	5	1	1	0	0	11	3	42	4
Flan filled with rice pudding	Sweet Fatty	7	35	4	1	1	0	0	2	1	13	5	44	2
Flan with fruit filling	Sweet Fatty	7	46	7	32	5	1	1	0	0	11	5	35	4
Fromage frais half fat with fruit	Sweet Fatty	9	48	4	22	2	1	0	1	1	3	2	45	3
Fromage frais low fat	Sweet Sour	7	2	1	51	2	1	0	1	1	0	0	35	3
Fromage frais low fat with fruit	Sweet Sour	7	29	2	29	3	1	0	0	0	3	2	37	1
Fruit cocktail in syrup tinned	Sweet Sour	9	37	4	10	2	0	0	1	0	2	2	9	3
Fruit drink concentrate can Albert Heijn	Neutral	8	37	2	5	2	1	1	0	0	2	1	1	1
Fruit drink concentrate fruitmix	Sweet Sour	8	65	10	18	5	0	0	0	0	0	0	5	2
Fruit drink concentrate Karvan Cevitam	Sweet Sour	7	42	2	8	4	1	0	0	0	2	2	2	1
Fruit drink concentrate undiluted	Sweet Fatty	12	70	4	15	5	1	0	0	0	2	2	5	2
Fruit juice concentrated	Sweet Sour	8	62	11	46	8	0	0	0	0	0	0	6	3
Fruit juice dk minimal 2 fruits	Sweet Sour	9	51	3	34	3	3	2	0	0	3	2	7	3
Fruit juice dk minimal 2 fruits with vitamin C	Sweet Sour	9	43	4	26	2	1	0	0	0	2	2	4	1
Fruit juice drink Roosvicee Multivitamin	Sweet Sour	9	39	4	35	3	1	0	0	0	2	2	1	1
Gateau fatless sponge with fruit & cream	Sweet Fatty	12	46	3	13	3	1	1	0	0	7	2	45	4
Gateau with whipped cream	Sweet Fatty	10	48	3	3	1	0	0	1	1	7	3	51	5
Gherkins sweet pickled	Sweet Sour	12	12	3	69	1	1	0	2	1	9	4	7	2
Grapes with skin average	Sweet Sour	12	30	3	25	3	2	1	0	0	1	0	5	2
Ham lean boiled	Savory fatty	12	5	1	5	2	0	0	31	6	46	3	41	5
Ham lean grilled	Savory fatty	7	4	2	9	3	1	0	26	8	43	5	40	7
Ham shoulder medium fat boiled	Savory fatty	12	8	2	6	3	1	1	23	5	45	3	39	5
Ham smoked raw	Savory fatty	8	3	2	4	1	1	1	27	6	65	5	57	5
Hamburger (pan-fried)	Savory fatty	9	9	2	5	2	1	0	31	7	46	5	54	4
Herring pickled (sweet)sour	Savory fatty	11	4	1	73	3	3	1	18	5	36	6	39	3
Herring salted	Savory fatty	8	3	1	11	4	2	1	40	7	50	4	58	4
Honey	Sweet Fatty	8	76	3	1	1	3	2	0	0	4	2	29	8

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Hot chocolate from vending machine	Sweet Fatty	11	48	3	2	1	8	3	0	0	5	3	14	3
Ice cream dairy cornet	Sweet Fatty	12	47	3	4	3	4	2	1	1	7	2	50	4
Ice cream dairy cream based	Sweet Fatty	8	48	4	2	1	0	0	0	0	5	3	52	2
Ice cream dairy with chocolate coating	Sweet Fatty	7	40	2	1	0	3	2	1	1	4	2	55	6
Ice cream stracciatella-	Sweet Fatty	7	47	4	1	0	4	2	1	1	7	3	47	3
Jam	Sweet Fatty	8	74	3	19	3	1	0	0	0	3	2	27	7
Jam reduced sugar	Sweet Fatty	8	58	5	19	4	1	1	0	0	4	2	26	7
Japanese rice cracker mix with peanuts	Neutral	7	16	2	1	1	1	1	16	6	26	5	18	2
Japanese rice cracker mix without peanuts	Neutral	8	9	2	2	1	1	1	10	3	28	5	9	1
Juice apple, Appelsientje, Goudappel	Sweet Sour	11	35	6	44	6	2	1	0	0	1	1	1	1
Juice drink	Sweet Sour	12	50	4	33	2	7	3	0	0	2	2	4	2
Juice drink Dubbelfrisss	Sweet Sour	11	37	4	23	4	1	1	0	0	2	2	4	2
Juice drink Spa&Fruit still	Sweet Sour	8	36	5	19	3	0	0	0	0	3	2	2	1
Juice drink Vruchtenfris/Tintelfruit	Sweet Sour	7	37	4	35	5	1	1	0	0	2	1	1	1
Juice drink Wicky	Sweet Sour	8	43	6	32	4	1	0	0	0	4	3	2	1
Juice drink with sugar & sweetener	Sweet Sour	7	53	4	24	4	3	2	0	0	2	1	4	1
Juice mixed fruit, AH BASIC Multivitaminedrank	Sweet Sour	11	40	5	30	6	3	1	0	0	1	1	2	1
Juice orange freshly squeezed	Sweet Sour	12	31	4	61	3	11	5	0	0	2	1	6	2
Juice orange with pulp	Sweet Sour	8	21	4	50	4	5	1	0	0	2	1	4	2
Juice orange, Appelsientje, Sinaasappel	Sweet Sour	11	32	3	42	6	2	1	0	0	1	1	2	1
Kale curly boiled	Neutral	7	3	1	1	0	7	2	2	2	2	1	4	3
Ketchup curry	Savory fatty	9	31	3	22	6	1	0	22	6	33	6	32	5
Ketchup tomato	Sweet Sour	9	28	3	42	6	1	1	22	6	29	6	27	5
Kiwi fruit	Sweet Sour	12	19	3	51	4	4	1	0	0	1	0	7	2
Kromesky meat filled (pan-fried)	Savory fatty	9	7	2	4	1	1	0	19	5	48	5	60	6
Leek boiled	Neutral	8	6	2	3	1	5	1	3	1	2	1	9	3
Lemonade squash Dubbelfrisss light	Sweet Sour	8	33	3	31	3	1	0	0	0	1	1	1	1
Lettuce head raw	Neutral	8	5	2	3	1	9	2	1	1	1	0	2	1

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Lettuce iceberg raw	Neutral	8	9	2	2	1	3	1	1	1	1	0	4	2
Lipton Ice Tea Lemon	Sweet Sour	12	39	3	29	3	4	2	2	1	3	2	5	3
Liquorice allsorts	Sweet Fatty	9	65	3	1	1	1	1	0	0	10	4	24	3
Liquorice Dutch type salted	Sweet Fatty	8	40	3	6	4	1	1	6	6	42	6	28	5
Liquorice Dutch type sweet	Sweet Fatty	12	33	3	2	1	4	2	1	1	19	4	22	4
Liver pate	Savory fatty	7	8	3	8	4	1	1	20	8	46	5	65	4
Liver pate sausage	Savory fatty	9	5	2	6	2	4	3	19	7	40	5	63	6
Liver pate/Berliner liver sausage	Savory fatty	11	7	2	11	3	2	1	27	5	31	5	59	3
Liver sausage	Savory fatty	8	7	2	3	2	2	1	32	6	41	3	63	4
Low fat margarine 40% fat <17 g salt	Fatty	8	3	1	1	1	0	0	2	2	12	2	89	3
Low fat margarine prod 35% fat <10 g salt	Fatty	9	2	1	1	1	1	0	1	1	2	1	84	6
Low fat margarine prod Blue Band Idee	Fatty	8	3	1	2	1	0	0	1	1	13	2	83	4
Low fat margarine product tub Becel Ligh	Fatty	8	1	1	1	1	0	0	1	1	3	1	78	7
Luncheon meat tinned	Savory fatty	12	8	3	8	2	1	0	24	5	37	3	49	5
M&M's chocolate with peanuts	Sweet Fatty	12	57	3	2	1	3	1	2	1	7	2	28	4
Macaroons	Sweet Fatty	8	58	4	1	0	1	1	1	0	9	4	28	4
Mackerel fillet smoked	Savory fatty	8	3	1	8	4	1	0	44	8	42	5	52	8
Mandarins	Sweet Sour	12	26	2	31	4	3	1	1	0	1	0	4	2
Margarine 80% fat >24 g saturates	Fatty	8	2	1	1	1	1	0	0	0	14	3	94	3
Margarine 80% fat 17-24 g saturates	Fatty	12	4	1	4	2	0	0	2	1	10	2	84	3
Margarine liquid 80% fat < 17g sat unsalted	Fatty	8	3	2	1	1	1	1	1	1	9	3	87	3
Margarine liquid 80% fat <17 g saturates	Fatty	11	3	2	2	1	1	1	2	1	13	2	88	4
Margarine product 60% fat <17 g sat	Fatty	12	2	1	5	3	1	1	2	1	4	1	78	6
Margarine product 70% fat >17 g sat	Fatty	11	2	1	2	1	1	0	2	1	14	2	84	5
Margarine product AlbertHeijn Bewust	Fatty	11	5	2	5	2	1	0	2	1	7	2	91	3
Margarine product tub Becel Dieet	Fatty	8	1	1	1	1	1	0	1	1	3	1	83	5
Marmite	Savory fatty	12	11	4	23	7	23	7	64	9	62	7	19	5
Marsh mellows	Sweet Fatty	8	65	1	2	2	0	0	0	0	2	2	33	7

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Mayonnaise	Fatty	9	10	2	33	4	1	0	8	4	25	6	76	4
Mayonnaise product approx 35% oil	Fatty	12	12	3	41	5	1	0	14	5	30	6	76	3
Mayonnaise yoghurt based 25% oil	Fatty	8	15	4	32	4	1	0	7	5	24	6	69	5
Meringue cake Bokkenpootje	Sweet Fatty	8	57	4	1	0	5	2	0	0	8	3	40	6
Milk chocolate-flavored Chocomel light	Sweet Fatty	9	40	3	1	1	8	3	1	1	6	3	35	2
Milk chocolate-flavored full fat	Sweet Fatty	9	37	4	2	2	7	3	0	0	6	3	39	2
Milk chocolate-flavored semi-skimmed	Sweet Fatty	9	42	3	4	2	7	2	1	1	5	2	35	3
Milk semi-skimmed	Neutral	12	12	1	4	1	1	0	1	0	3	1	20	3
Milk skimmed	Neutral	12	14	2	5	1	1	0	1	0	2	1	18	3
Milk whole	Neutral	12	12	1	4	1	1	0	1	0	3	1	20	3
Minced beef (pan-fried)	Savory fatty	9	4	2	3	1	1	0	11	4	22	3	49	7
Minced beef/pork (pan-fried)	Savory fatty	9	4	2	2	1	1	0	12	4	24	3	45	6
Minced meat beef/pork raw with egg/bread crumbs	Savory fatty	10	9	3	7	2	1	0	24	5	43	4	57	4
Minced meat loaf fried	Savory fatty	9	4	1	6	2	1	0	21	5	38	3	50	6
Minced meat with ham and cheese (pan-fried)	Savory fatty	7	4	2	6	2	1	1	29	9	41	4	55	6
Mineral water average	Neutral	12	2	1	17	4	19	6	0	0	2	1	3	2
Mineral water Spa (non-sparkling)	Neutral	11	1	0	1	0	4	1	1	1	1	0	4	3
Mixed nuts and raisins	Neutral	11	24	5	8	2	4	1	4	2	5	1	24	3
Mousse chocolate	Sweet Fatty	8	46	6	1	1	14	5	1	1	3	1	49	3
Muesli crunchy plain/with fruit	Neutral	8	35	5	8	2	1	0	1	0	10	3	10	2
Muesli crunchy with chocolate	Sweet Fatty	7	45	3	0	0	3	2	0	0	12	5	17	3
Muesli crunchy with nuts	Neutral	8	34	4	1	1	1	1	0	0	14	4	11	3
Muesli with fruit	Neutral	8	11	2	4	2	2	1	1	0	4	2	5	2
Mushrooms boiled	Neutral	8	7	2	3	1	2	1	18	3	5	2	18	6
Mustard	Savory fatty	7	6	3	47	10	10	6	5	3	37	9	31	4
Nuts mixed salted	Savory fatty	8	12	4	1	0	4	1	11	4	32	4	41	9
Oil olive	Fatty	8	1	1	0	0	17	10	1	1	3	2	98	2
Oil soya	Fatty	7	3	1	3	3	3	2	6	5	5	2	90	1
Oil sunflower seed	Fatty	11	2	1	1	0	1	1	1	1	4	1	91	5

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Oil wok average	Fatty	8	4	2	1	0	1	1	12	4	9	3	91	2
Olives tinned/glass	Neutral	9	4	1	6	2	4	2	18	5	31	5	19	6
Onions boiled	Neutral	8	7	2	4	1	3	0	5	1	2	1	12	5
Onions raw	Bitter	9	9	2	8	3	31	9	3	1	3	1	3	2
Orange	Sweet Sour	12	19	3	47	5	8	3	0	0	1	1	3	1
Pancake	Neutral	10	15	2	2	1	1	0	2	2	8	2	35	5
Pasta plain average boiled	Neutral	10	3	1	2	1	1	1	1	0	3	1	16	5
Pasta wholemeal boiled	Neutral	10	4	2	2	1	2	1	1	0	6	2	13	2
Pastry puff cheese filled (deep-fried)	Savory fatty	10	6	2	10	3	1	0	23	7	54	5	62	4
Pate	Savory fatty	8	15	4	6	2	2	2	26	7	46	5	66	4
Pea garden super fine tinned	Neutral	9	15	2	2	1	1	0	6	1	11	3	9	3
Peaches in syrup tinned	Sweet Sour	9	31	4	14	2	2	1	1	0	2	2	9	4
Peanut butter	Fatty	8	27	6	2	1	2	1	2	1	24	3	69	5
Peanut butter with nut pieces	Savory fatty	7	24	3	4	2	2	1	8	3	33	7	65	8
Peanut sauce jar prepared	Savory fatty	9	32	4	9	3	2	1	14	5	41	6	60	4
Peanuts coated	Savory fatty	8	11	3	3	2	2	1	24	7	43	5	43	7
Peanuts salted	Savory fatty	8	8	3	1	0	2	1	7	2	40	4	45	8
Peanuts sugar coated	Sweet Fatty	11	42	4	1	1	4	2	2	1	11	3	41	6
Pear with skin	Neutral	7	30	2	6	2	1	1	1	1	1	0	10	4
Pear without skin	Neutral	7	30	3	8	2	1	0	1	1	1	1	9	4
Peas and carrots tinned	Neutral	9	13	2	2	1	1	0	8	2	16	3	9	3
Peas frozen boiled	Neutral	9	15	2	2	1	1	0	5	2	4	2	8	2
Peppermint	Neutral	7	44	5	0	0	1	0	0	0	5	3	2	1
Pesto	Savory fatty	8	5	2	12	4	2	1	23	7	57	3	54	8
Pine nuts	Neutral	11	9	2	2	1	6	2	4	2	8	2	40	6
Pineapple	Sweet Sour	11	34	4	34	4	1	0	0	0	2	1	5	3
Pineapple in syrup tinned	Sweet Sour	9	38	4	20	3	0	0	0	0	3	2	6	2
Pizza margherita (warm)	Savory fatty	9	16	2	4	2	1	1	15	5	35	5	35	3
Popcorn sweet puffed	Sweet Fatty	9	43	3	2	1	1	1	1	1	8	4	21	4

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Pork chop (pan-fried)	Neutral	7	4	2	10	4	1	1	18	5	16	2	25	5
Pork fillet (pan-fried)	Neutral	9	5	2	9	3	1	0	14	6	16	3	30	4
Pork rib chop (pan-fried)	Neutral	8	4	2	4	2	0	0	14	4	16	4	21	3
Pork schnitzel breaded raw	Savory fatty	7	5	2	1	0	1	1	10	2	37	4	46	6
Pork schnitzel not breaded (pan-fried)	Neutral	10	5	2	7	2	1	0	16	6	18	3	25	3
Pork shoarma seasoning (pan-fried)	Savory fatty	9	11	3	3	1	0	0	32	7	50	4	59	4
Pork shoulder chop (pan-fried)	Savory fatty	9	4	2	2	1	0	0	12	5	24	4	47	6
Pork sparerib (oven)	Savory fatty	8	15	2	2	1	0	0	29	9	38	5	53	5
Pork tenderloin (pan-fried)	Neutral	9	4	2	9	3	1	0	14	6	17	3	34	5
Potato crisps oven baked	Savory fatty	7	15	4	8	3	1	0	18	5	44	3	31	9
Potato waffles/balls frozen (deep-fried)	Savory fatty	10	7	2	3	1	1	1	13	3	40	3	45	4
Potatoes boiled with skin average	Neutral	7	6	2	2	1	1	1	8	3	6	2	9	3
Potatoes mashed prepared with semi-skimmed milk and margarine	Savory fatty	10	7	2	3	1	1	0	15	3	44	3	36	5
Potatoes sliced frozen (pan-fried)	Savory fatty	7	6	2	1	1	1	0	13	5	26	4	45	7
Potatoes without skins boiled average	Neutral	12	5	1	2	1	1	0	7	1	8	1	13	2
Prawn crackers	Savory fatty	7	12	2	1	1	0	0	26	4	29	5	33	4
Pretzel sticks	Neutral	11	4	2	1	1	1	1	1	0	47	5	9	1
Pudding airy average	Sweet Fatty	10	63	3	9	2	2	1	5	4	8	3	55	3
Pudding semolina with red currant sauce	Sweet Fatty	8	46	4	10	3	2	1	3	2	6	3	46	2
Pudding vanilla	Sweet Fatty	8	48	4	2	1	0	0	0	0	4	2	51	3
Puff pastry baked	Neutral	10	3	1	2	1	2	1	1	0	32	3	15	4
Raisins dried	Sweet Fatty	9	51	5	11	3	0	0	1	0	2	1	13	2
Raisins soaked in water	Sweet Fatty	9	48	4	15	3	0	0	1	1	3	2	17	3
Rice brown boiled	Neutral	10	3	1	2	1	1	1	2	1	3	1	9	2
Rice cakes puffed	Neutral	8	3	1	0	0	1	1	1	1	7	1	4	1
Rice white boiled	Neutral	10	3	0	2	1	2	1	4	2	2	1	5	1
Roll brown hard	Neutral	12	6	1	4	1	1	1	1	0	14	2	9	2
Roll brown soft	Neutral	12	7	1	4	1	2	1	1	0	13	2	12	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Roll white hard	Neutral	12	7	1	3	1	1	0	1	0	14	2	10	2
Roll white soft	Neutral	12	8	1	4	1	2	1	1	0	13	2	13	3
Roll wholemeal soft	Neutral	8	7	1	3	1	2	1	1	1	16	2	10	2
Rosti prepared without fat (warm)	Savory fatty	9	9	2	3	2	1	1	15	4	35	1	29	3
Salad cream 25% oil	Fatty	7	11	3	33	7	2	1	8	4	32	9	68	5
Salad dressing honey/mustard	Savory fatty	7	15	4	41	7	2	2	14	8	40	9	66	2
Salad dressing vinaigrette	Savory fatty	7	10	3	56	8	2	2	11	6	41	10	66	9
Salami	Savory fatty	12	3	1	19	5	1	0	21	6	51	4	56	5
Salami sausage saveloy	Savory fatty	12	3	1	14	3	1	0	20	5	47	3	58	4
Salmon farmed prepared in microwave oven	Neutral	8	3	1	9	3	1	1	25	6	18	2	27	5
Salmon smoked	Savory fatty	8	3	1	10	4	1	0	36	6	53	3	57	6
Salmon tinned	Savory fatty	11	4	1	8	2	2	1	28	6	26	3	32	5
Sandwich meat chicken	Savory fatty	12	4	1	6	2	1	1	17	3	37	3	26	3
Sandwich spread original	Sweet Sour	8	19	3	45	5	1	0	13	5	24	7	36	6
Sauce for chips 25% oil	Fatty	9	12	2	37	5	1	0	8	4	28	6	74	3
Sauce tomato ready-made jar	Savory fatty	8	20	3	24	6	1	1	33	8	39	6	31	5
Sausage beef Braadworst (pan-fried)	Savory fatty	9	5	2	4	1	1	0	19	7	48	4	58	7
Sausage cooked	Savory fatty	12	3	1	5	2	0	0	23	4	37	3	47	5
Sausage Dutch Frikandel frozen (deep-fried)	Savory fatty	9	9	2	5	2	1	0	21	6	45	6	55	6
Sausage frankfurter tinned	Savory fatty	7	6	3	12	4	1	1	28	7	48	5	55	5
Sausage grill	Savory fatty	8	6	3	8	3	0	0	21	5	39	3	63	5
Sausage luncheon meat	Savory fatty	12	4	1	8	2	1	0	19	4	37	3	49	5
Sausage pork Braadworst (pan-fried)	Savory fatty	7	6	2	6	3	0	0	24	6	54	5	67	3
Sausage raw beef	Savory fatty	7	5	2	13	6	3	2	21	8	42	7	64	3
Sausage smoked beef cooked	Savory fatty	13	4	1	23	4	1	0	27	7	56	4	62	2
Sausage smoked lean cooked	Savory fatty	13	3	1	21	4	1	0	23	5	51	4	54	3
Sausage with smoked bacon-bits	Savory fatty	7	7	3	9	3	0	0	32	9	44	4	62	5
Shrimps Dutch peeled boiled	Savory fatty	10	8	2	4	2	1	0	31	3	33	3	31	5

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Silver-skin onions sweet pickled glass	Sweet Sour	8	10	3	53	5	2	1	2	1	12	5	10	4
Smoked sausage- cooked average	Savory fatty	8	6	2	20	3	1	1	18	7	42	6	59	6
Smoothie fruit	Sweet Sour	7	37	4	39	4	3	2	0	0	4	2	15	6
Snack sausage roll puff pastry	Savory fatty	10	7	2	4	2	1	0	17	6	45	4	55	6
Snack sausage roll with bread dough pastry	Savory fatty	10	9	3	6	2	1	0	19	7	38	4	31	4
Soft drink tonic	Bitter	8	24	3	22	5	38	8	0	0	2	2	1	0
Soft drink without caffeine	Sweet Sour	12	51	3	33	4	6	2	0	0	2	2	3	2
Soft drink, Coca-Cola, Light	Sweet Sour	11	46	4	20	6	3	1	0	0	1	1	1	1
Soft drink, Coca-Cola, Regular	Sweet Sour	11	41	5	23	7	5	2	0	0	1	1	1	1
Soup clear with meat and vegetables	Savory fatty	8	12	3	3	2	1	0	37	9	37	4	24	4
Soup clear with meat vegetables and noodles	Savory fatty	9	7	2	7	3	1	1	21	5	42	2	22	3
Soup cup-a-soup prepared	Savory fatty	9	10	3	6	2	3	2	21	6	39	2	25	2
Soup legume based ready-made prepared	Savory fatty	9	7	2	10	2	2	1	20	5	44	3	37	2
Soup main course with legumes and meat	Savory fatty	13	6	2	8	2	2	1	22	6	40	3	40	3
Soup thickened with meat and vegetables	Savory fatty	8	19	3	22	6	1	0	32	9	32	6	20	2
Soup vegetable based dried packet prepared	Savory fatty	12	8	2	3	1	1	0	31	7	45	3	23	4
Soup vegetable based tinned prepared	Savory fatty	9	19	2	16	4	1	1	27	7	32	4	26	2
Soya sauce sweet	Savory fatty	10	42	8	9	4	4	3	27	10	61	5	17	6
Spaghetti bolognese	Savory fatty	8	9	1	11	3	0	0	25	7	29	5	37	4
Spinach creamed frozen boiled	Neutral	9	6	2	3	2	2	1	10	4	30	2	16	4
Spinach frozen boiled	Neutral	7	7	2	4	2	8	3	3	1	4	2	7	5
Sports drink AA High Energy	Sweet Sour	8	56	4	19	4	1	1	0	0	5	3	3	1
Spread chocolade plain	Sweet Fatty	8	66	4	1	1	8	3	0	0	9	4	69	4
Spread chocolate Duo Penotti hazelnut	Sweet Fatty	8	66	4	1	0	2	1	2	1	9	4	70	3
Spread chocolate hazelnut	Sweet Fatty	8	63	5	1	0	3	1	3	2	9	4	69	2
Spread chocolate milk	Sweet Fatty	8	62	5	1	1	6	2	2	1	10	4	65	3
Spring roll frozen (deep-fried)	Savory fatty	10	11	2	6	2	1	1	26	5	36	4	51	6
Stock from cube prepared	Savory fatty	12	7	2	3	1	1	0	41	8	57	4	21	5

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Strawberries	Sweet Sour	12	18	3	34	3	1	0	0	0	1	0	8	3
Sugar granulated, with coffee	Bitter	11	25	2	5	2	43	6	1	0	1	1	3	2
Sugar granulated, with tea	Neutral	11	20	2	4	1	16	4	0	0	1	1	2	1
Sunflower seeds	Neutral	12	6	2	2	1	3	1	2	1	3	1	23	6
Sweet pepper green boiled	Neutral	9	7	1	5	2	19	3	4	1	3	1	15	7
Sweet pepper red boiled	Neutral	10	14	2	11	3	3	1	4	1	2	1	9	3
Sweet pepper yellow boiled	Neutral	9	16	1	8	3	2	1	3	1	3	1	12	4
Sweetener aspartame/acesulfame p tablet, with coffee	Bitter	7	10	2	2	1	51	7	1	0	2	2	3	2
Sweetener p tablet Natrena, with coffee	Bitter	7	17	2	2	2	46	7	0	0	1	1	4	2
Syrup apple	Sweet Fatty	8	64	8	29	5	3	1	1	1	6	4	28	7
Tapenade olive	Savory fatty	9	9	4	26	4	1	1	32	7	43	5	52	5
Tarts filled with jam	Sweet Fatty	8	61	2	10	4	2	1	1	0	11	4	41	4
Tea prepared	Neutral	11	4	1	5	1	20	4	1	0	1	0	2	2
Tilapia (pan-fried)	Neutral	7	6	2	5	2	1	0	15	5	12	4	21	5
Toast	Neutral	8	3	1	1	0	1	0	0	0	9	2	4	1
Toffee with chocolate	Sweet Fatty	8	68	1	1	0	3	1	0	0	10	4	64	4
Toffees	Sweet Fatty	8	66	5	1	0	1	1	0	0	11	4	47	5
Tomato average raw	Neutral	10	10	1	19	2	3	1	12	2	3	1	10	4
Tomato juice	Savory fatty	9	10	3	23	6	1	1	33	8	32	5	14	4
Tortellini boiled	Neutral	9	8	2	4	1	1	0	15	6	25	4	24	3
Tuna in oil tinned	Savory fatty	8	3	1	19	6	2	1	31	8	37	4	36	9
Tuna in water tinned	Neutral	12	4	1	16	2	2	1	22	4	25	3	19	4
Tuna (pan-fried)	Neutral	7	4	2	11	3	1	1	10	3	12	3	13	3
Waffle Luikse	Sweet Fatty	8	47	5	1	1	0	0	0	0	8	3	24	5
Waffle soft-/sugar-/flash-	Sweet Fatty	8	49	2	1	1	0	0	0	0	9	4	28	4
Waffle syrup average	Sweet Fatty	12	56	4	1	0	1	0	1	0	8	3	30	4
Walnuts unsalted	Neutral	7	5	2	1	0	12	2	6	3	2	1	22	4
Water average	Neutral	11	1	0	1	0	2	1	1	0	1	0	5	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Whey drink light Rivella	Sweet Sour	8	35	4	26	6	7	3	1	1	3	2	1	1
Whey drink Taksi with sugar	Sweet Sour	7	50	3	29	3	1	1	0	0	5	3	3	1
Whisky	Bitter	11	22	7	13	7	25	7	1	0	2	2	4	4
White fish fillet in batter deep-fried	Savory fatty	8	5	1	4	2	1	0	27	5	32	5	48	6
Wine gum with liquorice	Sweet Fatty	7	48	6	7	3	1	0	0	0	26	4	21	7
Wine gums	Sweet Fatty	7	49	4	21	5	0	0	0	0	4	3	22	6
Wine red	Bitter	11	8	1	46	4	38	7	2	2	1	1	2	1
Wine rose	Sweet Sour	13	13	2	43	6	24	6	1	0	1	1	1	0
Wine white dry	Sweet Sour	13	12	3	45	5	21	6	1	1	1	1	1	0
Wine white sweet	Sweet Sour	13	16	3	38	5	18	6	1	0	2	1	1	0
Wrap/Tortilla	Neutral	7	11	1	1	1	1	1	2	1	11	3	14	3
Yakult Original	Sweet Sour	12	50	4	38	4	3	1	3	1	3	1	13	3
Yoghurt cream- with fruit	Sweet Fatty	8	40	5	27	2	1	1	1	1	2	1	44	4
Yoghurt drink	Sweet Sour	9	32	3	27	2	1	1	1	1	4	2	29	2
Yoghurt drink Vifit fruit	Sweet Sour	8	34	3	27	4	0	0	1	1	4	2	26	3
Yoghurt drink with sweeteners Optimel	Sweet Sour	12	42	4	27	3	2	1	1	0	2	1	24	2
Yoghurt full fat	Sweet Sour	12	2	1	71	2	2	1	1	0	3	2	28	4
Yoghurt full fat stracciatella	Sweet Fatty	8	31	6	25	2	5	2	1	1	5	2	43	2
Yoghurt full fat with fruit	Sweet Fatty	9	40	3	28	3	1	0	1	1	4	2	42	3
Yoghurt full fat with fruit/muesli Activia	Sweet Fatty	11	34	4	20	4	2	1	1	0	4	2	37	2
Yoghurt half fat	Sweet Sour	12	6	1	49	3	2	1	1	0	1	1	27	3
Yoghurt low fat with fruit/van with sweeteners Optimel	Sweet Sour	8	33	3	32	3	1	1	1	1	5	3	33	3
Yoghurt low fat	Sweet Sour	12	2	1	67	3	2	1	1	0	3	1	25	3
Yoghurt low fat with fruit	Sweet Fatty	12	42	4	24	2	1	1	1	0	2	1	33	3
Yoghurt vanilla half fat	Sweet Sour	9	26	2	27	3	0	0	1	1	4	2	35	3

Table S2. Taste database of 423 Malaysian foods. For each food evaluated: Cluster (result of taste classification), number of evaluations (n), mean (m) and standard error (SE) for the five basic tastes and fat sensation

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Acar (Pickled cucumbers, carrots and pineapple dish)	Sweet Sour	14	16	1	22	2	1	0	2	1	3	1	7	1
Agar, mixed fruits	Sweet Sour	14	33	2	23	2	0	0	1	0	1	0	10	2
Agar, pandan with coconut milk	Sweet fatty	14	35	2	0	0	0	0	1	0	4	1	11	2
Agar, rose syrup	Sweet Sour	14	35	2	0	0	0	0	1	1	1	0	8	2
Ais kacang, (ice-blended) with rose syrup	Sweet fatty	12	48	2	1	0	1	0	1	1	2	1	15	3
Alcohol drink <1%, shandy	Sweet Sour	12	30	2	25	2	9	2	0	0	0	0	3	1
Alcohol drink 4%, cider, apple	Sweet Sour	12	31	2	38	3	13	1	0	0	0	0	3	1
Anchovy, fried with sambal	Savory fatty	12	10	1	6	2	3	1	28	4	57	2	34	2
Apple, green, Granny Smith	Sweet Sour	20	16	1	51	2	2	0	1	0	1	0	2	0
Apple, red, Gala	Sweet Sour	20	32	2	22	2	1	0	1	0	0	0	3	1
Banana, fresh, Berangan	Sweet Sour	20	42	2	7	1	1	0	2	1	1	0	7	1
Bean, baked, canned	Savory fatty	14	19	2	13	2	0	0	20	2	25	2	19	2
Bean, French, stir fried	Savory fatty	12	9	1	1	0	1	0	18	3	27	2	29	2
Bean, long, stir fried	Neutral	12	9	1	1	0	3	1	15	2	21	2	24	3
Bean, sprouts, stir fried	Savory fatty	12	6	1	0	0	2	1	21	3	24	1	32	3
Beef , *Rendang-style*	Savory fatty	13	7	1	3	1	2	1	39	4	44	2	46	2
Beef, cooked in curry	Savory fatty	13	6	1	2	1	2	1	37	4	32	2	45	3
Beef, cooked with coconut milk	Savory fatty	12	7	1	12	2	1	1	38	4	36	3	39	3
Beef, cooked with soy sauce	Savory fatty	13	10	2	2	1	1	0	33	4	34	2	43	3
Beef, fried	Savory fatty	12	4	1	2	1	1	0	24	3	24	2	31	3
Beef, *Paprik-style*	Savory fatty	13	20	2	8	2	0	0	36	4	33	2	37	3
Beef, spiced, grilled	Savory fatty	14	4	1	3	1	2	1	35	4	27	2	26	3
Beef, stir fried, with turmeric	Savory fatty	13	8	2	0	0	1	0	32	4	28	2	33	3
Beer 5% alcohol, Carlsberg	Bitter	12	5	1	23	3	53	3	1	1	0	0	3	1

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Beer 5% alcohol, Heineken	Bitter	12	5	1	19	3	53	2	0	0	1	0	3	1
Beer 5% alcohol, Tiger	Bitter	12	5	1	20	3	48	3	1	1	0	0	2	1
Bell pepper, stir fried	Neutral	15	5	1	4	1	2	1	12	2	16	1	22	2
Bitter gourd, cooked with egg and turmeric	Savory fatty	12	4	1	3	1	30	2	23	4	26	2	30	3
Bread, white, Gardenia	Neutral	20	8	1	4	1	1	0	2	1	6	1	7	1
Bread, white, Massimo	Neutral	20	9	1	2	1	1	0	3	1	6	1	8	1
Bread, whole meal, Gardenia	Neutral	20	6	1	6	1	3	1	2	1	6	1	5	1
Bread, whole meal, Massimo	Neutral	20	5	1	3	1	2	0	2	1	6	1	5	1
Brinjal, stir fried with sambal	Savory fatty	12	10	2	1	0	3	1	22	3	26	2	44	3
Broccoli, stir fried	Savory fatty	12	2	1	0	0	3	1	20	2	33	3	24	2
Bun, kaya	Sweet fatty	20	50	2	3	1	1	0	2	1	8	1	21	2
Bun, lotus filling, steamed	Sweet fatty	12	49	2	2	1	0	0	2	1	4	1	19	2
Bun, plain	Neutral	20	19	1	2	1	1	0	1	1	5	1	14	1
Bun, pork, BBQ, baked	Savory fatty	12	28	2	1	0	0	0	22	4	30	2	28	2
Bun, pork, BBQ, steamed *Char Siew pau*	Savory fatty	12	27	2	2	1	0	0	17	3	27	2	27	1
Bun, pork, steamed *Bapau*	Savory fatty	12	14	2	1	0	0	0	25	4	29	2	31	3
Bun, red bean fillings	Sweet fatty	20	39	2	3	1	2	0	2	1	9	1	18	1
Bun, spicy anchovy filling, Gardenia	Savory fatty	13	11	2	4	1	2	1	19	3	25	2	22	2
Burger, beef, cheese, McD	Savory fatty	14	6	1	15	2	0	0	27	3	29	2	34	2
Burger, beef, Ramly	Savory fatty	13	15	2	13	2	1	0	37	3	31	2	45	3
Burger, chicken, Colonel, KFC	Savory fatty	12	9	2	9	1	0	0	22	4	33	2	37	3
Burger, chicken, McD	Savory fatty	12	9	2	11	1	0	0	23	4	33	2	38	3
Burger, chicken, Ramly	Savory fatty	13	17	1	14	2	0	0	32	3	29	2	44	3
Burger, chicken, Zinger, KFC	Savory fatty	12	8	2	7	1	0	0	26	4	38	2	41	3
Burger, egg *banjo*, Ramly	Savory fatty	13	16	1	11	2	0	0	25	3	24	1	39	3
Burger, fish fillet, McD	Savory fatty	12	7	2	20	2	0	0	23	3	30	2	34	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Burger, *Roti John*	Savory fatty	12	9	1	4	1	0	0	24	3	29	2	33	2
Cabbage, *Siew Pak Choy*, stir fried	Savory fatty	12	2	0	0	0	10	1	14	2	23	2	28	3
Cabbage, stir fried	Savory fatty	12	7	1	0	0	2	1	21	3	25	2	38	3
Cabbage, turmeric, *mamak style*, stir fried	Neutral	12	4	1	4	1	1	0	6	1	24	2	18	3
Cake, banana	Sweet fatty	12	42	2	3	1	1	0	1	1	3	1	25	3
Cake, brown sugar, steamed	Neutral	12	29	2	1	1	0	0	2	1	8	1	15	1
Cake, butter	Sweet fatty	12	40	2	2	1	0	0	1	0	4	1	31	3
Cake, chocolate	Sweet fatty	14	43	3	1	0	2	1	4	1	6	1	31	3
Cake, fruit	Sweet fatty	14	51	3	12	2	1	0	4	1	6	1	31	2
Cake, layered, original, Apollo	Sweet fatty	12	55	2	6	2	0	0	1	5	2	1	28	2
Cake, sponge, Chinese style	Sweet fatty	12	35	2	1	0	0	0	0	0	4	1	13	2
Cake, sponge, Massimo	Sweet fatty	13	39	2	1	0	0	0	1	1	4	1	23	2
Calamari ring, fried	Savory fatty	12	3	1	5	2	1	0	20	3	42	2	38	4
Candy, black current-flavored	Sweet Sour	13	43	2	17	2	0	0	1	1	0	0	9	2
Candy, caramel	Sweet fatty	13	54	2	2	1	2	1	0	0	4	1	36	3
Candy, chocolate, milk, M&Ms	Sweet fatty	13	56	2	0	0	3	1	0	0	5	1	38	3
Candy, chocolate, peanut, M&Ms	Sweet fatty	20	59	3	0	0	4	2	2	1	6	2	41	4
Candy, ice lemon tea-flavored	Sweet Sour	13	38	3	14	2	2	1	1	0	2	1	5	1
Candy, Kopiko	Sweet Sour	13	40	2	2	1	12	2	1	1	0	0	7	1
Candy, mint, chocolate-filled	Sweet fatty	13	45	3	1	1	2	1	0	0	0	0	18	3
Candy, mint, Mentos	Sweet Sour	13	42	2	1	1	4	2	1	0	0	0	6	1
Cauliflower, stir fried	Savory fatty	13	6	1	1	0	2	1	16	3	28	2	27	3
Cereal beverage, 3 in 1, Nestum	Neutral	13	25	1	2	1	0	0	0	0	3	1	10	2
Cereal beverage, 3 in 1, with oats, Nestum	Neutral	13	17	1	1	0	0	0	1	1	2	0	12	2
Chicken, spiced, grilled	Savory fatty	12	5	1	2	1	1	0	28	4	28	2	36	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Chicken ball, fried	Savory fatty	12	5	1	1	0	0	0	22	3	29	2	27	2
Chicken, cooked with soy sauce	Savory fatty	13	18	2	13	2	0	0	28	4	32	2	34	2
Chicken, curry	Savory fatty	12	4	1	2	1	1	0	33	4	32	2	47	2
Chicken, fried, original, KFC	Savory fatty	13	3	1	0	0	0	0	21	4	30	2	46	3
Chicken, fried, spiced, *mamak style*	Savory fatty	13	5	1	2	1	0	0	16	3	28	3	37	3
Chicken, fried, spicy, KFC	Savory fatty	13	4	1	0	0	0	0	28	4	33	2	50	3
Chicken, *Kurma*	Savory fatty	13	9	2	1	1	1	0	36	4	34	2	41	3
Chicken, *masak merah* (Malay-style)	Savory fatty	13	14	2	1	0	0	0	28	4	35	2	33	2
Chicken, meatball, boiled	Savory fatty	12	5	1	1	0	0	0	24	4	27	2	21	2
Chicken, *Paprik-style*	Savory fatty	13	19	2	12	2	0	0	27	4	28	2	30	2
Chicken, *Rendang*	Savory fatty	12	11	1	4	1	2	1	39	4	38	2	43	2
Chicken, stir fried, with turmeric	Savory fatty	13	7	1	3	1	2	1	26	4	34	2	30	2
Chicken, sweet and sour	Savory fatty	12	27	2	26	1	0	0	31	3	28	2	38	2
Chickpeas, boiled	Neutral	14	7	1	2	1	0	0	6	1	21	2	9	2
Chinese cabbage, *Pak-choy*, stir fried	Savory fatty	12	2	1	3	1	6	1	8	2	38	2	36	3
Chinese kale, *Kailan*, stir fried	Savory fatty	12	2	1	1	0	4	1	13	2	26	2	34	3
Chinese kale, *Kailan*, stir fried with salted fish	Savory fatty	12	2	1	1	1	2	1	18	3	40	2	37	3
Chips, banana, original	Neutral	14	9	2	1	0	1	0	7	2	23	2	21	2
Chips, potato, original, Mister Potato	Savory fatty	15	7	1	1	0	1	0	8	2	36	2	23	1
Chips, tapioca, original	Neutral	14	5	2	1	0	4	1	5	1	30	2	19	2
Chips, tapioca, spicy	Sweet fatty	14	33	2	2	1	0	0	5	1	18	2	22	2
Chocolate, bar, Kit Kat	Sweet fatty	15	64	2	0	0	3	1	0	0	5	1	49	3
Chocolate, bar, malted, Cloud9	Sweet fatty	13	53	2	1	0	2	1	0	0	12	2	53	2
Chocolate, milk, bar	Sweet fatty	13	66	2	0	0	8	2	1	1	4	1	65	2
Cockle, stir fried, with sambal	Savory fatty	14	9	1	4	1	5	1	40	3	32	2	29	2
Coffee, 3 in 1, Nescafe	Bitter	20	25	1	1	0	34	2	1	1	0	0	11	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Coffee, canned, Nescafe	Bitter	13	32	2	4	1	42	3	0	0	3	1	9	2
Coffee, with condensed milk	Bitter	20	41	2	2	1	31	2	1	0	1	0	14	2
Coffee, with sugar	Sweet Sour	20	59	2	2	1	26	3	1	1	0	0	6	1
Coleslaw, KFC	Neutral	13	15	2	8	1	4	1	8	3	11	1	22	2
Cookies, chocolate chips, Chipsmore	Sweet fatty	14	48	2	1	1	6	1	1	0	8	2	28	2
Cordial, blackcurrant, Ribena	Sweet Sour	15	47	2	31	2	1	0	0	0	1	1	4	2
Cordial, orange, Sunquick	Sweet Sour	15	22	2	44	2	4	1	0	0	3	1	4	1
Corn snack, BBQ-flavored, Twisties	Savory fatty	13	5	1	5	2	1	0	25	2	36	2	12	2
Corn snack, cheese-flavored, Chezeels	Savory fatty	14	5	2	4	1	0	0	43	2	38	1	20	2
Corn snack, chicken-flavored, Twisties	Savory fatty	13	6	1	1	1	0	0	26	3	29	3	14	2
Corn, baby, stir fried with mixed vegetables	Savory fatty	12	10	1	2	1	1	0	21	3	23	1	27	2
Crab ball, breaded, fried	Savory fatty	12	7	1	2	1	0	0	41	3	26	3	28	2
Crab stick	Savory fatty	12	7	1	1	0	0	0	48	3	17	3	16	2
Crab, cooked in chili	Savory fatty	14	13	2	4	1	1	0	35	3	25	2	30	3
Crab, cooked in coconut milk	Savory fatty	14	6	1	3	1	1	0	43	3	33	2	34	3
Cracker peanuts snack	Savory fatty	13	10	2	0	0	1	0	20	3	20	1	25	3
Cracker, prawn	Savory fatty	13	5	1	1	1	2	1	29	2	24	2	21	2
Cracker, prawn, Rota	Savory fatty	14	4	1	0	0	0	0	48	1	28	2	18	2
Crackers, chocolate-sandwiched, Munchy's	Sweet fatty	12	34	3	1	1	1	1	2	1	18	2	30	2
Crackers, cream, coated with sugars, Munchy's	Neutral	13	22	2	0	0	0	0	2	1	11	1	18	2
Crackers, cream, Hup Seng	Neutral	20	3	1	1	0	0	0	1	1	17	1	14	1
Crackers, cream, Hwa Tai	Neutral	20	3	1	1	0	1	0	2	1	19	1	17	1
Crackers, cream, vegetable-flavored, Munchy's	Neutral	12	11	1	0	0	0	0	4	1	18	1	21	1
Crackers, fish (*ikan Tambun*)	Savory fatty	12	2	1	0	0	1	0	31	3	22	2	23	2
Crackers, fish, original, Cap Pinggan	Savory fatty	12	2	1	0	0	0	0	40	4	24	2	16	2
Crackers, fish, sweet and spicy	Sweet fatty	12	34	2	1	1	0	0	20	3	24	3	21	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Crackers, peanut-butter sandwiched, Julie	Sweet fatty	12	35	3	0	0	0	0	2	1	22	2	36	2
Crackers, sandwiched, Oreo	Sweet fatty	12	50	3	1	0	2	1	0	0	8	2	31	3
Custard, corn-flavored	Sweet fatty	12	42	2	1	0	0	0	2	1	1	0	13	2
Custard, strawberry-flavored	Sweet fatty	12	44	2	1	0	0	0	1	1	0	0	12	2
Custard, vanilla-flavored	Sweet fatty	12	40	2	0	0	0	0	2	1	0	0	13	2
Cuttlefish, cooked with sambal	Savory fatty	12	17	1	10	2	1	0	33	3	31	2	33	2
Date, *kurma*, dried	Sweet fatty	12	56	3	4	1	2	1	4	1	2	1	15	2
Dim sum, *Lo mai kai* (glutinous rice, with chicken, steamed)	Savory fatty	14	15	1	1	1	2	0	38	3	30	2	40	2
Dim sum, pork, steamed *Siew mai*	Savory fatty	12	7	1	1	0	0	0	31	4	30	2	31	2
Dim Sum, yam cake, steamed, with savory chili sauce	Savory fatty	12	12	1	3	1	0	0	12	2	33	2	32	2
Drink, barley	Sweet Sour	12	28	2	0	0	0	0	2	1	1	0	3	1
Drink, energy, Livita	Sweet Sour	12	34	2	45	4	6	2	1	0	3	1	2	1
Drink, energy, Redbull	Sweet Sour	12	43	3	44	4	4	1	1	0	2	1	2	1
Drink, grass jelly *Cincau*	Sweet Sour	12	48	2	0	0	1	0	4	1	1	0	3	1
Drink, lime	Sweet Sour	12	33	3	32	2	1	0	0	0	0	0	2	1
Drink, packet, Chrysanthemum	Sweet Sour	13	42	2	0	0	2	1	1	1	1	0	0	0
Drink, packet, lychee	Sweet Sour	12	49	2	12	2	0	0	1	1	1	0	6	2
Durian	Sweet fatty	13	43	3	4	2	6	1	6	2	4	1	24	4
Eggs, hen, braised	Savory fatty	12	6	1	2	1	1	1	25	3	30	2	19	2
Eggs, hen, fried	Savory fatty	13	1	1	0	0	0	0	17	3	12	2	35	3
Eggs, hen, hard boiled	Neutral	20	2	0	0	0	1	0	13	2	9	1	13	2
Eggs, hen, omelet	Savory fatty	12	8	1	1	1	1	0	13	3	39	2	27	2
Eggs, salted	Savory fatty	15	1	0	4	1	1	0	16	2	62	2	15	2
Fish "*satay*" snack	Neutral	12	20	2	2	1	1	0	22	3	17	2	21	3
Fish ball, fried	Savory fatty	13	4	1	0	0	0	0	35	3	35	3	25	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Fish, African bream, cooked in coconut milk	Savory fatty	15	4	1	8	1	1	0	34	3	39	2	33	3
Fish, African bream, fried in chili	Savory fatty	15	8	1	8	1	1	0	34	3	32	2	31	3
Fish, black pomfret, fried	Savory fatty	12	3	1	1	1	2	1	29	3	35	2	27	2
Fish, black pomfret, fried in chili	Savory fatty	13	6	1	8	2	1	0	29	3	32	2	29	2
Fish, catfish, cooked with coconut milk	Savory fatty	12	4	1	4	1	1	0	36	4	32	2	38	3
Fish, catfish, fried	Savory fatty	12	4	1	0	0	1	0	21	2	23	2	34	3
Fish, catfish, fried with chili	Savory fatty	14	7	1	6	1	1	0	33	3	34	2	37	2
Fish, Hairtail scad, cooked with soy sauce	Savory fatty	15	8	1	2	1	1	0	33	3	32	2	35	3
Fish, Hairtail scad, fried in chili	Savory fatty	12	13	1	11	2	1	0	34	3	33	2	29	2
Fish, Indian mackerel, canned, black bean sauce	Savory fatty	13	3	1	3	1	1	0	47	3	49	2	31	4
Fish, Indian mackerel, cooked in tamarind	Savory fatty	12	4	1	11	2	2	1	37	3	37	2	35	2
Fish, Indian mackerel, cooked with *Tauchoo*	Savory fatty	15	6	1	5	1	1	0	35	3	44	2	37	3
Fish, Indian mackerel, fried	Savory fatty	12	2	1	3	1	4	1	33	3	34	2	28	2
Fish, mackerel, Spanish, cooked in curry	Savory fatty	12	4	1	23	2	1	0	20	4	38	2	32	3
Fish, sardine, canned, in tomato sauce, with bread	Savory fatty	14	5	1	3	1	1	0	30	2	25	2	24	2
Fish, sardine, canned, tomato sauce	Savory fatty	13	6	1	9	2	2	1	43	3	28	2	28	3
Fish, sweet and sour	Savory fatty	13	28	2	16	2	0	0	28	3	27	2	32	2
Fish, tuna, canned, mayonnaise, with bread	Savory fatty	13	6	1	10	2	0	0	25	2	22	2	19	2
Fish, tuna, cooked in coconut milk	Savory fatty	14	4	1	8	2	1	0	34	3	31	2	32	3
Fish, tuna, cooked in curry	Savory fatty	14	4	1	8	1	1	0	35	3	31	2	40	3
Fish, yellow-banded travelly, cooked in tamarind	Savory fatty	14	3	1	14	2	1	0	34	3	35	2	42	4
French fries, original, KFC	Savory fatty	13	5	2	0	0	0	0	13	3	25	2	30	2
French fries, original, McD	Neutral	13	4	1	3	1	1	1	8	2	21	2	30	3
French fries, with chili sauce, KFC	Savory fatty	13	18	2	9	2	0	0	14	3	25	2	30	2
French fries, with chili sauce, McD	Neutral	13	17	2	9	2	1	0	11	3	22	1	28	3
French fries, with tomato ketchup, KFC	Savory fatty	13	16	2	24	3	0	0	19	3	24	2	29	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
French fries, with tomato ketchup, McD	Savory fatty	13	16	2	26	2	1	0	21	2	23	2	30	2
Gizzard, chicken, cooked in sambal	Savory fatty	14	10	1	2	1	5	1	23	3	26	2	31	3
Glutinous rice, turmeric, *Nasi kunyit* with curry chicken	Savory fatty	14	8	1	2	1	1	0	27	3	35	2	38	2
Glutinous rice, with durian and coconut milk	Sweet fatty	14	41	3	3	1	3	1	2	1	15	2	35	2
Glutinous rice, with mango and coconut milk	Sweet fatty	14	39	2	8	1	0	0	3	1	16	2	35	2
Gourd bottle, stir fried	Savory fatty	12	9	1	4	1	1	0	24	3	24	2	26	3
Grape, purple	Sweet Sour	20	34	2	8	1	4	1	1	0	1	0	2	0
Grape, red	Sweet Sour	20	39	2	11	1	2	0	1	0	1	0	3	1
Groundnuts, Cap Tangan	Neutral	12	3	1	0	0	2	1	13	3	14	2	13	2
Guava, dried	Neutral	15	16	2	28	2	1	0	3	1	12	2	8	1
Guava, fresh	Sweet Sour	20	15	1	25	2	3	1	2	1	2	0	2	1
Guava, fresh, with preserved prune powder *Asam buoy*	Sweet Sour	12	28	2	37	2	3	1	1	1	10	2	4	1
Honey dew, fresh	Neutral	12	20	2	2	1	1	0	0	0	0	0	4	1
Ice cream, chocolate-flavored	Sweet fatty	12	52	2	0	0	3	1	0	0	0	0	44	3
Ice cream, red bean	Sweet fatty	14	49	3	0	0	1	0	2	1	6	1	24	3
Ice cream, strawberry-flavored	Sweet fatty	12	57	2	2	1	0	0	0	0	0	0	41	3
Ice cream, Sundae, McD	Sweet fatty	12	56	3	0	0	0	0	0	0	0	0	44	4
Ice cream, vanilla-flavored	Sweet fatty	12	54	2	0	0	0	0	0	0	0	0	43	3
Ice cream, yam-flavored	Sweet fatty	14	52	2	0	0	1	0	2	1	4	1	26	3
Isotonic drink, 100 plus, original	Sweet Sour	15	32	2	20	3	2	1	0	0	7	1	4	1
Jackfruit, dried	Sweet Sour	12	35	2	7	2	0	0	2	1	2	1	8	2
Jackfruits, fresh	Sweet Sour	13	28	2	6	2	1	0	3	1	2	1	6	1
Jam, pineapple, with bread	Sweet Sour	14	48	3	21	3	0	0	1	0	3	1	18	2
Jam, *Seri kaya*, with bread	Neutral	13	28	2	2	1	0	0	0	0	9	2	16	2
Jam, strawberry, with bread	Sweet Sour	14	48	3	21	3	0	0	3	2	6	1	18	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Juice, apple, Marigold Peel Fresh	Sweet Sour	13	46	2	31	3	1	0	1	1	2	1	4	1
Juice, guava, Marigold Peel Fresh	Sweet Sour	12	42	2	29	2	0	0	1	1	1	1	7	2
Juice, mango, Marigold Peel Fresh	Sweet Sour	13	42	2	32	3	1	0	2	1	3	1	6	1
Juice, orange, Marigold Peel Fresh	Sweet Sour	12	36	2	41	2	4	1	1	0	1	0	3	1
Juice, orange, Tropicana Twister	Sweet Sour	12	46	2	35	2	2	1	0	0	1	0	4	1
Kuih, Ang ku kueh, green bean filling	Sweet fatty	12	38	1	1	0	1	0	2	1	11	1	21	2
Kuih, Ang ku kueh, peanut filling	Sweet fatty	12	46	0	1	1	1	0	3	1	19	2	26	2
Kuih, Apam ayu	Sweet fatty	13	30	2	5	1	1	0	2	1	21	2	20	2
Kuih, Apam kukus	Sweet Sour	12	29	3	9	2	0	0	1	0	3	1	8	1
Kuih, Cekodok pisang	Sweet fatty	13	34	3	7	1	1	1	1	1	11	2	36	2
Kuih, Cucur udang (no sauce)	Savory fatty	13	4	1	2	1	2	1	24	3	29	2	36	2
Kuih, Cucur udang, with sweet chili sauce	Savory fatty	12	24	2	16	3	1	0	24	3	24	3	33	2
Kuih, dodol (Sweet confection with palm sugar)	Sweet fatty	13	53	2	1	0	2	1	4	1	9	2	27	3
Kuih, dodol durian (Sweet confection with durian flavors)	Sweet fatty	13	50	3	2	1	1	0	4	1	9	1	26	3
Kuih, donut, coated with sugar	Sweet fatty	14	39	2	1	0	0	0	1	1	7	1	27	3
Kuih, Hamchi Peng, with glutinous rice fillings	Savory fatty	12	16	1	1	1	0	0	5	2	22	1	38	2
Kuih, Hamchi Peng, with red bean fillings	Sweet fatty	12	30	2	1	1	0	0	3	1	14	1	37	2
Kuih, kapit	Sweet fatty	14	34	2	0	0	0	0	3	1	4	1	13	2
Kuih, karipap (curry puff)	Savory fatty	13	16	1	1	1	1	0	12	2	24	2	33	2
Kuih, Keropok Lekor, with sweet chili sauce	Savory fatty	13	23	2	5	1	1	1	41	3	35	2	29	3
Kuih, ketayap	Sweet fatty	13	52	2	4	1	0	0	3	1	11	2	23	3
Kuih, lapis	Sweet fatty	14	37	2	1	1	0	0	0	0	5	1	26	3
Kuih, Onde-onde	Sweet fatty	13	50	3	1	1	2	1	2	1	9	1	19	2
Kuih, pisang goreng (Fried banana)	Sweet fatty	13	32	2	8	1	2	1	1	1	10	1	41	3
Kuih, pulut panggang	Savory fatty	13	15	2	3	1	1	1	17	3	25	2	31	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Kuih, Rempeyek (deep-fried savory cracker with peanuts)	Neutral	13	6	1	0	0	2	0	13	2	21	2	24	4
Kuih, Seri Muka	Sweet fatty	14	37	2	2	1	0	0	5	2	9	2	29	3
Kuih, Talam	Sweet fatty	12	41	3	1	0	0	0	2	1	36	2	31	4
kuih, Yau Char Kue	Neutral	13	6	1	1	1	1	0	3	1	16	2	29	3
Lady's finger, stir fried	Savory fatty	12	4	1	0	0	2	1	24	3	26	2	38	3
Lamb chop	Savory fatty	13	11	2	5	1	2	1	36	4	38	3	41	3
Liver, chicken, cooked with sambal	Savory fatty	14	11	1	3	1	15	2	27	3	25	2	34	3
Liver, chicken, cooked with turmeric	Savory fatty	14	2	1	1	0	16	2	24	3	20	3	20	2
Lolly ice, orange-flavored	Sweet Sour	12	31	2	34	3	0	0	1	1	0	0	2	1
Lolly ice, rose syrup-flavored	Sweet Sour	12	39	3	0	0	0	0	1	1	0	0	2	1
Longan, canned, in syrup	Sweet Sour	12	53	2	8	2	0	0	2	1	1	0	4	1
Longan, fresh	Sweet Sour	13	43	2	3	1	0	0	2	1	1	1	6	2
Loofah, cooked in coconut milk	Savory fatty	12	13	2	0	0	4	1	28	4	28	2	34	3
Lungs, beef, fried in chili	Savory fatty	14	7	1	2	1	4	1	23	3	26	2	31	3
Lychee, canned, in syrup	Sweet Sour	13	43	3	19	2	0	0	1	1	1	0	6	1
Malted drink, 3 in 1, Horlick	Sweet fatty	20	35	2	2	1	1	0	2	1	4	1	20	2
Malted drink, chocolate, Ovaltine	Sweet fatty	13	37	3	0	0	4	1	2	1	1	1	17	3
Malted drink, chocolate-flavored, Vico	Neutral	13	24	2	0	0	7	1	1	1	2	1	16	3
Malted drink, Milo, with condensed milk	Sweet fatty	20	51	2	1	0	5	1	2	1	1	0	17	2
Malted drink, packet, Milo	Sweet fatty	20	50	2	2	1	5	1	3	1	2	1	22	2
Mandarin, green, local	Sweet Sour	20	20	1	42	2	3	0	1	0	1	0	2	0
Mandarin, imported, Chinese	Sweet Sour	20	31	2	32	2	3	1	1	0	1	0	3	1
Mango, dried	Sweet Sour	12	43	2	25	3	0	0	2	1	1	1	8	2
Mango, fresh, Chok Anan	Sweet Sour	12	42	2	15	2	2	1	0	0	0	0	5	2
Milk, pasteurized, low fat	Neutral	12	17	2	4	1	0	0	2	1	3	1	29	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Milk, powder, Anlene	Neutral	12	20	2	2	1	1	0	1	6	2	1	26	3
Milk, powder, low fat	Neutral	12	16	1	1	1	0	0	1	1	2	1	28	3
Milk, soy bean, Drinho	Sweet fatty	20	34	2	1	0	1	0	3	1	2	0	18	2
Milk, soy bean, Yeo's	Sweet fatty	20	41	2	1	0	1	0	2	1	1	0	15	2
Milk, UHT, chocolate	Sweet fatty	12	45	3	1	1	4	1	0	0	2	1	32	3
Milk, UHT, full cream	Neutral	12	15	1	3	1	0	0	1	0	3	1	28	3
*Murtabak, c*hicken, with red onion sauce	Savory fatty	14	12	1	21	2	3	1	30	3	34	2	33	3
Mushroom, oyster, spiced, deep-fried	Savory fatty	12	2	1	2	1	2	1	16	3	47	2	43	3
Mushroom, oyster, stir fried	Savory fatty	12	5	1	1	1	3	1	33	3	20	2	29	3
Mushroom, Shitake, stir fried with *Siew Pak-choy*	Savory fatty	12	5	1	1	1	3	1	26	3	21	2	17	2
Mushroom, Shitake, stir fried with soy sauce	Savory fatty	12	5	1	1	1	3	1	35	4	26	2	20	2
Mustard leaves, *choy-sam*, stir fried	Neutral	13	2	0	1	0	26	2	7	1	25	1	22	2
Mutton, cooked in curry	Savory fatty	14	10	2	5	2	1	1	33	3	40	2	44	3
Noodles, *Bandung-style*	Savory fatty	12	10	1	6	1	0	0	40	3	29	2	34	3
Noodles, curry	Savory fatty	12	8	1	3	1	1	0	31	4	35	2	47	4
Noodles, dry, with soy sauce	Neutral	12	4	1	0	0	2	1	7	2	20	1	25	3
Noodles, instant, chicken flavored	Savory fatty	13	3	1	1	0	0	0	37	3	40	3	18	3
Noodles, instant, curry flavored	Savory fatty	13	4	1	8	2	1	0	33	4	34	3	17	2
Noodles, instant, dry, Sedap	Savory fatty	13	7	1	2	1	1	1	32	3	26	2	20	2
Noodles, instant, fried, *mamak style*	Savory fatty	13	6	2	1	0	0	0	20	2	29	2	23	2
Noodles, instant, snack, BBQ flavored, Mamee	Savory fatty	12	5	1	2	1	0	0	28	4	30	2	14	2
Noodles, instant, snack, chicken flavored, Mamee	Savory fatty	12	4	1	1	0	0	0	25	3	31	2	13	2
Noodles, instant, tomyam flavored	Savory fatty	13	4	1	32	3	1	0	34	4	36	3	20	3
Noodles, *Mihun*, fried	Savory fatty	12	4	1	0	0	2	1	14	2	31	2	32	2
Noodles, *Mihun*, soup	Savory fatty	13	3	1	4	1	1	0	28	4	27	1	27	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Noodles, prawn *Mee udang*	Savory fatty	12	14	1	2	1	2	0	39	4	24	2	37	3
Noodles, rice, fried in egg gravy, Cantonese- style *Wa tan hor*	Savory fatty	13	6	1	3	1	1	0	34	3	29	2	34	3
Noodles, rice, *Kuey Teow*, fried	Savory fatty	12	2	1	3	1	1	0	18	3	33	2	39	2
Noodles, rice, *Kuey Teow*, soup	Savory fatty	13	3	1	5	1	1	0	27	3	28	1	30	2
Noodles, rice, *Laksa*, asam, Penang-style	Savory fatty	12	6	1	24	2	2	1	32	4	31	2	30	3
Noodles, rice, *Laksam*, with shredded vegetables and spicy coconut milk sauce	Savory fatty	12	9	1	5	1	4	1	21	3	25	2	37	3
Noodles, *Yee Mee*, Cantonese-style	Savory fatty	13	5	1	2	1	1	0	41	3	37	3	32	3
Noodles, yellow, fried	Savory fatty	12	3	1	2	1	3	1	18	3	41	3	38	2
Nugget, chicken, Ayamas	Savory fatty	14	3	1	1	0	1	0	22	3	34	2	34	2
Nugget, chicken, Ramly	Savory fatty	13	5	1	3	1	0	0	29	3	30	2	28	2
Orange, fresh, Sunkist	Sweet Sour	20	28	2	36	2	5	1	1	0	1	0	3	1
Papaya, fresh	Sweet Sour	20	31	2	2	0	2	0	2	1	1	0	3	1
Pastry, *Beh Teh Soh*, with sticky maltose sugar fillings	Sweet fatty	12	34	2	3	1	0	0	4	1	19	2	21	1
Pastry, cream puff	Sweet fatty	13	35	2	1	0	0	0	2	1	13	2	42	2
Pastry, *Lao Po Beng*, with winter melon and almond paste fillings	Sweet fatty	12	41	2	1	0	0	0	2	1	13	1	22	1
Pastry, *Tau Sar Piah*, with savory green bean fillings	Sweet fatty	12	31	2	2	1	0	0	3	1	26	2	20	2
Pear, fresh	Sweet Sour	12	32	2	1	0	0	0	1	0	0	0	3	1
Peas, snow, stir fried	Neutral	12	8	2	0	0	2	0	17	3	16	1	25	3
Pineapple, canned, in syrup	Sweet Sour	13	52	2	29	2	0	0	2	1	2	1	6	1
Pineapple, fresh	Sweet Sour	20	21	2	50	2	0	0	1	1	2	1	2	0
Pizza, beef pepperoni, Domino	Savory fatty	14	10	2	13	2	1	0	34	3	31	2	40	2
Pizza, beef pepperoni, Pizza Hut	Savory fatty	14	8	1	8	1	0	0	32	3	33	2	38	2
Pizza, chicken pepperoni, Domino	Savory fatty	12	9	1	16	2	1	0	28	3	33	2	32	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Pizza, Hawaiian chicken, Pizza Hut	Savory fatty	13	16	1	18	2	1	0	30	3	31	2	34	2
Pizza, seafood, Domino	Savory fatty	12	8	1	12	2	0	0	26	3	31	2	32	2
Pizza, seafood, Pizza Hut	Savory fatty	13	17	1	13	2	0	0	39	3	29	2	35	3
Pork, *Ba kut teh (*Cooked in broth with spice and herb)	Savory fatty	12	7	1	2	1	4	1	26	4	32	2	39	2
Pork, BBQ Chinese style, *Char Siew*	Savory fatty	12	24	2	1	0	0	0	25	4	28	2	33	2
Pork, braised	Savory fatty	12	6	1	1	1	4	1	24	3	35	2	52	3
Pork, cooked with preserved vegetables	Savory fatty	12	6	1	13	2	1	0	40	4	50	2	49	3
Pork, dried, Chinese, *Ba Kwa*	Savory fatty	12	23	2	1	1	1	0	22	3	28	3	32	2
Pork, leg, cooked with soy sauce and vinegar	Savory fatty	12	10	1	24	2	1	0	14	3	27	2	53	3
Pork, luncheon	Savory fatty	12	3	1	5	2	0	0	28	3	38	2	4	2
Pork, minced, steamed with eggs	Savory fatty	12	6	1	0	0	0	0	27	3	36	2	37	2
Pork, minced, stir fried with egg tofu	Savory fatty	12	9	1	2	1	0	0	32	4	33	2	32	2
Pork, minced, stir fried with soy sauce	Savory fatty	12	13	2	2	1	0	0	27	4	39	2	44	3
Pork, roasted	Savory fatty	12	4	1	1	0	1	0	18	4	46	2	44	3
Pork, roll, spiced, fried *Lobak*	Savory fatty	12	8	1	2	1	0	0	35	3	38	2	32	1
Pork, stir fried with ginger onion	Savory fatty	12	6	0	1	1	1	0	28	4	32	2	30	2
Pork, sweet and sour	Savory fatty	12	28	1	30	1	0	0	27	4	30	2	33	2
Porridge, black glutinous rice, with coconut milk	Sweet fatty	14	36	2	0	0	1	0	5	1	5	1	22	2
Porridge, green bean, with coconut milk	Sweet fatty	14	33	2	3	1	1	0	4	1	13	2	20	2
Porridge, red bean, with coconut milk	Sweet fatty	14	39	2	1	1	1	0	4	1	11	2	21	2
Potato, cooked in curry	Savory fatty	12	11	1	2	1	1	1	21	3	28	1	38	3
Potato, mashed, KFC	Savory fatty	13	7	1	2	1	0	0	34	4	32	2	29	3
Potato, stir fried with sambal	Savory fatty	12	15	1	3	1	0	0	26	3	24	2	33	2
Potato, sweet, fried	Sweet fatty	13	27	2	3	1	1	0	6	2	17	1	28	2
Prawn, cooked with sambal	Savory fatty	12	19	2	5	1	1	0	31	4	26	2	33	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Prawn, cooked with stinky bean and sambal	Savory fatty	12	11	1	5	1	4	1	36	3	22	2	32	2
Prune, dried	Sweet Sour	12	31	2	25	3	1	0	2	1	2	1	16	2
Pumpkin, stir fried	Neutral	12	13	2	0	0	0	0	18	3	17	1	26	3
Raisin	Sweet Sour	15	33	1	18	2	1	0	1	0	1	0	7	1
Rambutan, fresh	Sweet Sour	13	33	2	10	2	1	0	1	0	1	1	5	1
Rice porridge, chicken	Savory fatty	12	4	1	2	1	0	0	26	3	46	3	24	2
Rice porridge, chicken, McD	Savory fatty	12	5	1	1	1	0	0	32	3	38	2	26	3
Rice porridge, fish	Savory fatty	12	5	1	0	0	0	0	42	4	33	3	29	3
Rice porridge, pork, with century eggs	Savory fatty	12	7	1	2	1	1	1	30	3	43	2	28	3
Rice porridge, with salted vegetables	Neutral	13	4	1	16	2	0	0	10	1	27	3	15	3
Rice, chicken-flavored, with fried chicken	Savory fatty	12	26	2	10	2	0	0	28	4	27	2	36	2
Rice, chicken-flavored, with roasted chicken, Chinese style	Savory fatty	12	5	1	0	0	0	0	26	3	39	2	40	2
Rice, chicken-flavored, with steamed chicken, Chinese style	Savory fatty	12	8	1	1	0	0	0	29	3	38	2	48	3
Rice, coconut milk-flavored, *Nasi Lemak*	Savory fatty	12	18	2	9	2	2	1	27	4	46	2	39	2
Rice, flavored, *Briyani* (rice only)	Neutral	12	4	1	1	0	0	0	7	1	8	2	18	3
Rice, flavored, *Briyani*, with spicy chicken	Savory fatty	12	5	1	4	1	1	0	23	3	25	2	34	4
Rice, flavored, *Nasi dagang*, with tuna curry	Savory fatty	12	8	1	8	2	1	0	36	3	29	2	35	4
Rice, flavored, *Nasi kerabu*, with fried chicken	Savory fatty	12	9	2	16	2	3	1	30	4	37	3	30	4
Rice, flavored, *Nasi minyak*, with chicken *kurma*	Savory fatty	12	4	1	4	2	1	0	33	4	33	2	41	4
Rice, flavored, *Nasi tomato*, with spicy chicken	Savory fatty	14	12	1	5	1	0	0	23	3	27	2	37	3
Rice, fried, *Pattaya*	Savory fatty	12	9	1	4	1	1	0	28	3	30	2	36	4
Rice, fried, with anchovy and water convolvulus, *Nasi goreng kampung*	Savory fatty	12	4	1	1	0	0	0	17	2	32	2	29	3
Rice, fried, with chicken and frozen vegetables *Nasi goreng biasa*	Savory fatty	12	6	1	1	1	1	0	19	3	27	2	30	3
Rice, white, fragrant	Neutral	20	3	1	1	0	1	0	3	1	1	0	5	1

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Rice, white, non-fragrance	Neutral	12	5	1	0	0	0	0	1	0	1	0	3	1
Roll, cream, chocolate, Gardenia	Sweet fatty	13	44	3	3	1	1	0	1	0	6	1	28	3
Roll, cream, corn, Gardenia	Sweet fatty	13	35	2	4	1	0	0	1	0	7	1	25	2
Roll, cream, vanilla, Gardenia	Sweet fatty	13	38	2	4	1	0	0	1	0	6	1	28	2
Roll, Swiss, chocolate	Sweet fatty	12	47	2	0	0	2	1	1	1	4	1	29	3
Roti Canai, banana	Sweet fatty	13	43	3	9	2	1	0	5	2	11	1	37	3
Roti Canai, egg, *(Roti telur)* with dhal gravy and sambal	Savory fatty	13	11	2	8	2	1	0	13	3	33	2	30	2
Roti Canai, egg, *(Roti telur)* with dhal gravy	Savory fatty	13	8	1	4	1	1	1	13	3	26	2	29	2
Roti Canai, plain, with dhal gravy	Savory fatty	13	8	1	5	1	1	0	12	3	27	2	30	2
Roti Canai, plain, with dhal gravy and sambal	Savory fatty	13	13	1	8	2	2	1	14	3	34	2	32	2
Roti Canai, *tisu*, with sugar and condensed Milk	Sweet fatty	12	58	3	0	0	0	0	0	0	12	2	24	3
Satay, beef, with peanut sauce	Savory fatty	13	26	2	4	1	2	0	32	4	24	2	44	4
Satay, chicken, with peanut sauce	Savory fatty	13	26	2	3	1	2	1	30	4	23	2	44	3
Sausage, chicken cheese, fried	Savory fatty	13	7	1	4	1	1	0	28	3	41	2	38	2
Sausage, chicken, fried	Savory fatty	13	6	1	2	1	0	0	23	3	32	2	32	2
Sausage, Chinese, steamed	Savory fatty	12	19	2	3	1	0	0	35	3	35	2	52	3
Soft drink, Coca cola, original	Sweet Sour	15	49	2	23	3	3	1	0	0	3	1	5	2
Soft drink, F&N, orange	Sweet Sour	15	43	2	28	3	9	1	0	0	2	1	5	2
Soft drink, Fanta, grape	Sweet Sour	15	53	2	26	3	2	1	0	0	2	1	5	2
Soft drink, Pepsi, original	Sweet Sour	15	49	2	22	3	3	1	0	0	2	1	5	2
Soup, Chinese cabbage *Pak-choy*	Savory fatty	13	9	2	0	0	1	0	39	4	33	2	30	3
Soup, fish ball	Savory fatty	12	5	1	1	1	2	1	39	3	42	3	30	3
Soup, loofah	Savory fatty	12	14	2	1	0	4	1	29	4	28	1	35	4
Soup, lotus root with pork spare ribs	Savory fatty	12	8	2	2	1	0	0	33	4	38	2	36	3
Soup, pork ball	Savory fatty	12	6	2	0	0	1	0	35	4	34	2	27	3

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Soup, sliced beef	Savory fatty	12	5	1	10	2	1	0	38	4	36	3	34	3
Soup, tomyam, chicken	Savory fatty	13	12	1	28	1	0	0	28	4	33	2	32	2
Soup, tomyam, seafood	Savory fatty	13	12	1	30	2	0	0	39	5	33	2	33	2
Soup, *wonton* (pork dumpling)	Savory fatty	12	5	2	1	0	0	0	26	3	34	3	32	2
Spinach, green, stir fried	Savory fatty	12	4	1	0	0	2	1	22	3	25	3	30	3
Spinach, red, stir fried	Savory fatty	13	3	1	1	1	3	1	19	3	34	2	27	3
Spread, butter, with bread	Savory fatty	14	6	1	1	0	0	0	0	0	16	2	58	3
Spread, margarine, with bread	Savory fatty	14	5	1	1	0	0	0	1	0	27	2	57	3
Spring roll, vegetables, fried	Neutral	13	9	1	1	0	1	0	6	1	23	2	27	2
Squid ball, breaded, fried	Savory fatty	12	6	1	2	1	1	0	32	2	24	3	26	2
Starfruits, fresh	Sweet Sour	13	15	1	28	2	2	0	1	1	1	0	4	1
Stinky bean, stir fried with sambal and anchovy	Savory fatty	12	11	2	7	2	8	1	28	4	48	3	35	2
Stout, Guinness Foreign Extra	Bitter	12	4	1	24	2	68	2	0	0	0	0	3	1
Sweet corn, commercial, DailyFresh	Sweet fatty	13	26	2	1	1	0	0	7	2	19	2	31	4
Sweet corn, steamed	Neutral	12	15	1	0	0	0	0	0	0	2	1	6	1
Sweet leaf bush, cooked with pumpkin and coconut milk	Savory fatty	12	22	2	0	0	3	1	32	4	26	2	35	2
Syrup, rose, *bandung*, with condensed milk	Sweet fatty	13	53	3	1	1	0	0	0	0	0	0	13	3
Syrup, rose, *bandung*, with evaporated and condensed milk	Sweet fatty	14	49	2	2	1	0	0	1	1	1	0	22	3
Syrup, rose, home recipe	Sweet Sour	14	36	2	1	1	0	0	0	0	0	0	5	2
Syrup, rose, shop-recipe	Sweet fatty	13	72	2	0	0	0	0	0	0	0	0	5	1
Taufufa, with brown sugar (soy bean mustard)	Neutral	14	24	2	1	0	0	0	1	0	2	1	15	2
*Taufufa, w*ith white sugar (soy bean mustard)	Sweet Sour	12	40	3	1	0	0	0	2	1	1	1	8	2
Tea, milk, 3 in 1	Sweet Sour	13	29	2	0	0	12	2	0	0	1	0	7	1
Tea, plain	Bitter	20	3	1	1	0	24	2	1	0	0	0	2	0
Tea, with condensed milk	Sweet fatty	20	37	2	1	0	11	1	1	1	1	0	16	2

Food	Cluster	n	Sweet		Sour		Bitter		Umami		Salt		Fat	
			m	SE	m	SE	m	SE	m	SE	m	SE	m	SE
Tea, with sugar	Sweet Sour	20	60	2	1	1	8	1	2	1	0	0	4	1
Tea, with sugar and lime	Sweet Sour	20	40	2	29	2	7	1	1	0	0	0	4	1
Tempe, (fermented soy bean) ,stir fried with sambal	Savory fatty	12	12	2	5	1	1	0	19	2	27	2	30	2
Tofu, braised	Neutral	12	4	1	4	1	0	0	12	2	19	2	19	2
Tofu, egg, cooked with corn starch gravy	Savory fatty	12	9	2	1	0	0	0	26	4	26	2	31	3
Tofu, firm, fried with sambal	Neutral	12	13	2	8	2	0	0	9	2	14	1	10	2
Tofu, firm, stuffed *Tauhu sumbat*	Neutral	13	19	1	8	2	0	0	4	1	6	1	17	2
Tomato, cherry, raw	Neutral	12	9	2	23	3	0	0	35	3	1	0	6	1
Ulam, (local salad) lettuce, with sambal *belacan*	Neutral	12	6	1	4	1	7	1	13	3	20	3	6	1
Ulam, long bean, with sambal *belacan*	Neutral	12	6	1	5	1	8	2	12	3	13	2	5	1
Ulam, tomato, with sambal *belacan*	Neutral	12	9	1	14	1	0	0	24	1	11	2	8	1
Ulam, winged bean, with sambal *belacan*	Neutral	12	4	1	6	1	7	1	12	2	20	2	7	1
Ulam, cabbage, with sambal *belacan*	Neutral	12	7	1	7	2	1	0	15	3	26	2	8	1
Ulam, cucumber, with sambal *belacan*	Neutral	12	6	1	2	1	4	1	11	3	11	2	5	1
Water convolvulus, *Kangkung*, stir fried	Savory fatty	12	2	1	1	1	3	1	19	3	30	2	37	2
Water convolvulus, *kangkung*, stir fried with sambal *belacan*	Savory fatty	13	2	0	3	1	3	1	23	3	43	2	29	3
Water, filtered	Neutral	20	1	0	1	0	1	0	1	0	1	0	0	0
Water, mineral, Cactus	Neutral	20	1	0	1	0	1	0	1	0	1	0	0	0
Water, mineral, Spritze	Neutral	20	1	0	1	0	1	0	1	0	1	0	0	0
Watermelon, fresh	Neutral	20	25	1	1	0	0	0	1	5	1	0	2	0
White coffee, 3 in 1, Old Town	Bitter	20	32	2	1	0	42	3	2	1	1	0	14	2
White coffee, canned, Old Town	Bitter	13	34	2	4	1	36	2	0	0	2	1	9	2
Young coconut, fresh	Neutral	13	25	2	9	1	1	0	1	1	4	1	10	2