ASSESSMENT OF NUTRITIONAL AND PHYSICAL PROPERTIES OF NATIONWIDE VERSUS LOCAL BREAD

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By

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ABSTRACT

The general objective of this study was to determine the nutritional value of nationwide and local bread brand whereas the specific objective of this study was to compare the nutritional value and physical properties between nationwide and local bread brand. Four selected brands each of nationwide and local bread Kota Bharu, Kelantan were used in the study. The nutritional values of each bread were determine by conducting the proximate composition analysis according to AOAC (1996) for moisture, total ash, fat content, and protein. The total carbohydrate was calculated by the difference. The physical properties of each bread were determined. Bread crumb structure image analysis was viewed using ImageJ software programme. The mean value of moisture, ash and protein were found to be highest in the nationwide bread brands while the mean value of fat and carbohydrate were found to be highest among the local bread brands. There was significant difference in total ash only whilst no significant different were observed in moisture, fat, protein and carbohydrate. The mean value of hardness, springiness and chewiness were higher in local bread while mean value of cohesiveness was higher in nationwide bread. There was no significant difference of hardness, cohesiveness, springiness and chewiness between nationwide and local bread. The mean value of total number of cell and cell density were higher in local bread meanwhile the mean value of total cell area and average cell size are higher among nationwide bread. There was no significant difference in total number of cells, total cell area, average cell size and cell density between nationwide and local bread.

ABSTRAK

Objektif umum kajian ini adalah untuk menentukan nilai pemakanan roti berjenama yang terdapat di seluruh negara dan roti berjenama yang terdapat di kawasan tempatan sahaja manakala objektif khusus kajian ini adalah untuk membandingkan nilai khasiat pemakanan dan ciri-ciri fizikal antara kedua kumpulan jenama roti tersebut. Empat jenama terpilih dari setiap kumpulan jenama roti yang terdapat di Kota Bharu, Kelantan telah digunakan dalam kajian ini. Nilai pemakanan bagi setiap roti ditentukan dengan menjalankan analisa proksimat komposisi mengikut panduan daripada AOAC (1996) bagi kelembapan, jumlah abu, kandungan lemak, dan protein oleh faktor nitrogen. Jumlah karbohidrat dikira dengan perbezaan. Sifat-sifat fizikal setiap roti juga ditentukan. Analisa struktur imej serdak roti dilakukan menggunakan program perisian ImageJ. Nilai purata kelembapan, abu dan protein paling tinggi nilainya dalam jenama roti di seluruh negara manakala nilai purata lemak dan karbohidrat tertinggi nilainya dalam kalangan jenama roti tempatan. Terdapat perbezaan yang signifikan bagi jumlah abu sahaja manakala tidak perbezaan signifikan bagi kelembapan, lemak, protein dan karbohidrat. Nilai purata kekerasan, keelastikan dan kekunyahan adalah lebih tinggi dalam roti tempatan manakala nilai purata kesepaduan adalah lebih tinggi pada roti di seluruh negara. Tidak ada perbezaan yang signifikan bagi kekerasan, kesepaduan, keelastikan dan kekunyahan antara roti di seluruh negara dan tempatan. Nilai purata jumlah sel dan kepadatan sel lebih tinggi dalam roti tempatan manakala nilai purata jumlah kawasan sel dan purata saiz sel adalah lebih tinggi dalam kalangan roti di seluruh negara. Terdapat perbezaan yang signifikan bagi jumlah bilangan sel-sel, jumlah kawasan sel, purata saiz sel dan ketumpatan sel antara roti di seluruh negara dan tempatan.

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LIST OF ABBREVIATION

AOAC	Association of Analytical Communities
CHO	Carbohydrates
TPA	Texture Profile Analysis

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF STUDY

Wheat is known to be the most popular cereal grain which is consumed worldwide and it is used for the production of numerous baked products such as bread, biscuits, cookies, doughnuts and cakes (Ndife, Obiegbunna, & Ajayi, 2013). Over the past decades, changing food habits has increased demand for wheat-based convenient foods such as bread and pastries in many developing countries (Akingbala, Falade, & Ogunjobi, 2011; Aboaba & Obakpolor, 2010; Abdelghafor, Mustafa, Ibrahim, & Krishna, 2011). Out of all wheat-based food production, bread is the most commonly baked product (Ndife, Obiegbunna, & Ajayi, 2013). Bread is one of the oldest known and most important food products, having been consumed worldwide for many years (Paton, 2013). Bread is a staple foodstuff and it is eaten in most countries around the world (Ndife, Obiegbunna, & Ajayi, 2013). Bread, usually called the staff of life, differs greatly in size, shape, texture, appearance, and flavour (Wheat Food Councils, 2007).

1.2 RATIONALE

It is known that there are several nationwide and local bread available in Malaysia specifically in Kota Bharu, Kelantan. The nationwide bread might have provided accurate information on nutritional values however local bread does not provide the information. Most consumers said that bakery bread is fresher than commercial bread however it is not scientifically proven. Hence, it is very crucial to identify and compare the nutritional values and physical properties between nationwide and local bread. Besides, the comparison of nutritional values and physical properties are important to determine which bread is better. It is very important to analyse both nutritional values and physical properties as the results may vary significantly from each other. Other than that, there is a lack of information or analysis of nutritional values and physical properties of nationwide and local bread available in Malaysia. Therefore, this study can help consumers to choose the best bread suitable for them in order to full-fill their appetite. In this study, proximate contents, texture profile and bread crumb structure of the commercial and bakery bread were analysed.

1.3 RESEARCH QUESTION

a) Is there any significant difference in nutritional values between nationwide and local bread?

b) Is there any significant difference in physical properties between nationwide and local bread?

1.4 RESEARCH OBJECTIVE

1.4.1 GENERAL OBJECTIVE

a) To determine the nutritional values and physical properties of nationwide and local bread

1.4.2 SPECIFIC OBJECTIVE

a) To compare the nutritional values between nationwide and local bread

b) To compare the physical properties between nationwide and local bread

1.5 RESEARCH HYPOTHESIS

Null Hypothesis 1:

There is no significant difference in nutritional values between nationwide and local bread

Alternative Hypothesis 1:

There is significant difference in nutritional values between nationwide and local bread

Null Hypothesis 2:

There is no significant difference in physical properties between nationwide and local bread

Alternative Hypothesis 2:

There is significant difference in physical properties between nationwide and local bread

1.6 CONCEPTUAL FRAMEWORK

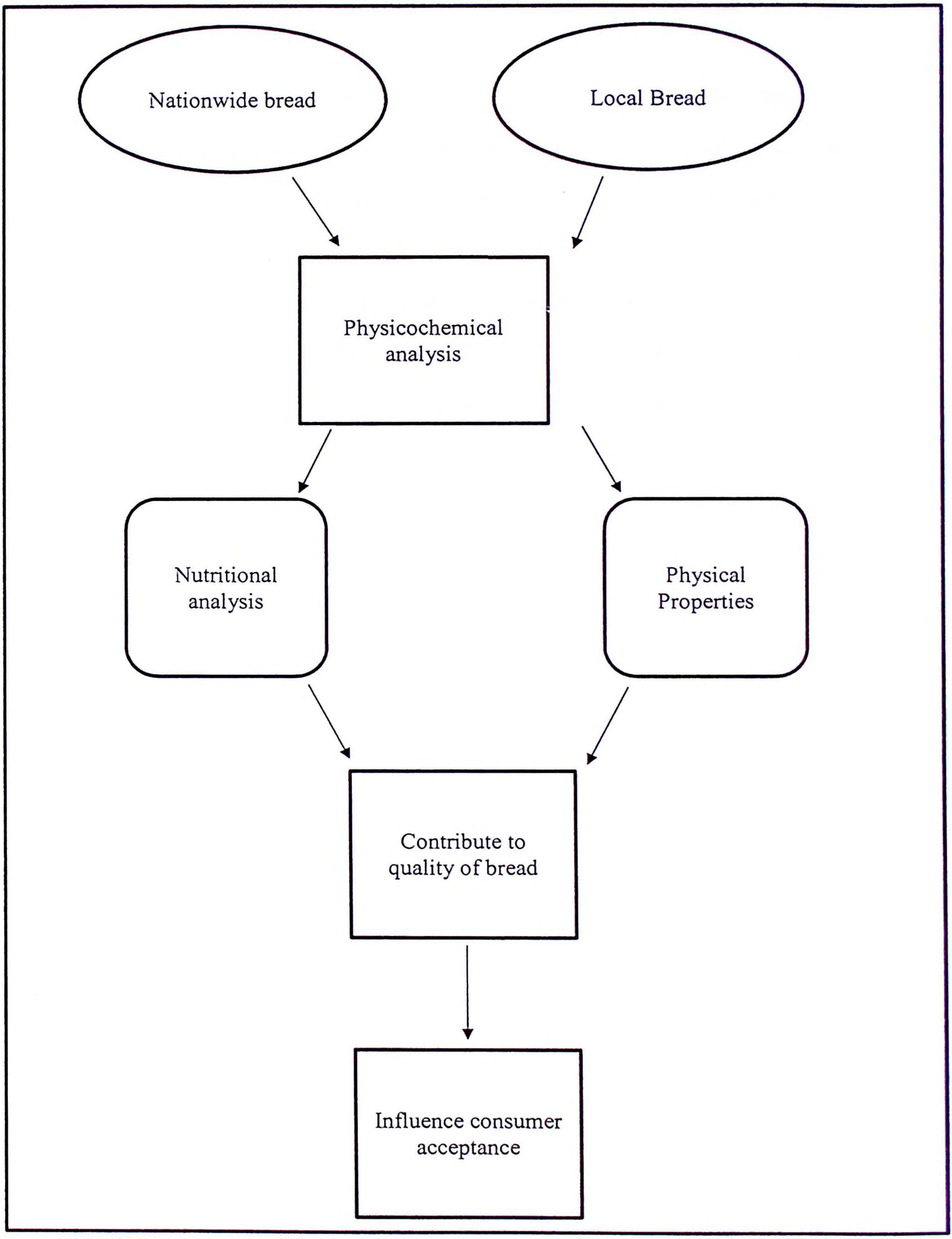

Figure 1: Conceptual Framework

CHAPTER 2: LITERATURE REVIEW

2.1 THE HISTORY OF BREAD

The origins of bread can be traced back as far as the Palaeolithic Period (c. 30,000 BC), because the evidence of processing starch has been found on ancient grindstones (Revedin, et al., 2010). Moreover, bread was used as a travelling food for wandering nomads that helped them to populate the earth (Revedin, et al., 2010). About 10,000 BC, man first started eating a crude form of flat bread which is a baked combination of flour and water (Wheat Food Councils, 2007). It is also believed that leavened bread was probably not consumed until Neolithic times (the 'New Stone era', c. 10,000 BC) when the chemical power of yeast was discovered (Kent, 2012). Leavened bread is the expanded dough produced by yeast fermentation (Kent, 2012). Ancient Egyptians often credited with inventing the oven and discovering yeast leavening (Wheat Food Councils, 2007). This is because by around 3,000 BC they started fermenting flour and water mixtures by using wild, air-borne yeast. They eventually added sugar, salt and flavourings such as poppy and sesame seeds. Thus, bread became part of an Ancient Egyptian's staple diet along with beer (Tannahill, 2002). Later, it became ubiquitous across the world in Roman times (Paton, 2013). During this modern time, it is one of few food products consumed across both the developed and developing world and spans almost every culture (Paton, 2013).

2.2 THE PRODUCTION OF BREAD

Bread production encompasses several of fundamental biochemical, chemical and physical processes (Paton, 2013). For examples, evaporation of water, volume expansion, gelatinization of starch, protein denaturation, crust formation, carbon dioxide production, formation of a porous structure and browning reactions (Purlis & Salvadori, 2009a.). There are five key stages in bread production. The first key stage is formation of dough which involves mixing and binding of raw ingredients and shaping the dough pieces (Paton, 2013). Secondly, proving stage whereby the dough is supplied with heat and humidity to encourage the yeast to ferment and the dough to rise (Paton, 2013). Third stage is baking where the dough is heated at high temperature to evaporate moisture and convert fragile dough to stable bread (Paton, 2013). Next, cooling stage includes lowering the temperature of the bread to ambient (Paton, 2013). Lastly, slicing, packaging and distribution are the final preparations made before the bread is delivered to the customer (Paton, 2013).

The core ingredients for bread production are flour, water, yeast, fat and salt (Paton, 2013). However, bread is a product varies vastly depending on the ratio of these ingredients, additional ingredients and production methods (Paton, 2013). The variations in taste and texture are particularly noticeable across country borders (Paton, 2013). For instance, the British standard loaf is largely unavailable in France, where the baguette is the mainstay product, and in Germany which is one of the highest consumers per capita where darker, denser products are often preferred (Paton, 2013). Besides, Mediterranean bread is often influenced by olive flavours, Middle-Eastern and Asian cultures typically consume flat-bread type products whilst Latin-American countries consume more corn/tortilla style baked products (Paton, 2013).

2.3 THE TYPE OF BREAD

There are many types of yeast bread which come in a variety of shapes, including flatbreads such as pita or focaccia, buns, rolls and loaves in the form of hearth or pan breads. The pan breads can be made from enriched white flour, whole wheat, or a combination of flours that are baked in loaf pans for a softer crust (Wheat Food Councils, 2007). It may include coarse-textured home-style, richer premium, and buttery split-top breads (Wheat Food Councils, 2007). The hearth breads are baked directly on the hearth for crispier crusts (Wheat Food Councils, 2007). For instance, some white hearth breads include French, Italian and Vienna bread while whole grain varieties include wheat, rye and pumpernickel are popular as well (Wheat Food Councils, 2007). The whole wheat bread labelled as 100% Whole Wheat is made entirely from whole grain wheat flour that contains all the components of the wheat kernel such as the germ, bran and endosperm whereas wheat bread contains a mixture of about 75 percent of white flour and 25 percent whole wheat flour (Wheat Food Councils, 2007). The mixed grain breads are other grain or vegetable flours for examples rye, oat, triticale, buckwheat, amaranth, potato, alfalfa, soy and barley, that are used in addition to wheat (Wheat Food Councils, 2007). The variety breads are bread with variety of flavours and seasoned breads from the sweet fruity and nutty flavours to the savoury and spicy (Wheat Food Councils, 2007).

CHAPTER 3: MATERIALS AND METHODS

3.1 RESEARCH DESIGN

The research design that has been chosen is an experimental study. This experimental study was undertaken to determine the nutritional values and physical properties of nationwide and local breads.

3.2 SAMPLE SELECTION

The sample selection includes four selected nationwide and local breads purchased from nearby area Kota Bharu, Kelantan. Firstly, several hypermarkets and bakeries located around Kota Bharu, Kelantan has been surveyed. Next, nationwide and local bread were identified which afterwards was taken into consideration for sample selection. Then, the samples were labeled as brands A-D for nationwide bread and brands E-H for local bread. All samples were purchased and taken to the laboratory for further analysis.

3.3 TYPE OF SAMPLE

Category of bread	Brands
Nationwide bread	Brand A
	Brand B
	Brand C
	Brand D
Local bread	Brand E
	Brand F
	Brand G
	Brand H

Table 1: The category of bread with differents brand labelling

3.4 INCLUSION AND EXCLUSION CRITERIA

3.4.1 INCLUSION CRITERIA

- Nationwide bread purchased from the hypermarkets in Kota Bharu, Kelantan.
- Local bread purchased from the bakeries in Kota Bharu, Kelantan.
- White sandwich bread only
- Has not meet the expire date

3.4.2 EXCLUSION CRITERIA

- Nationwide bread purchased from the hypermarkets outside Kota Bharu, Kelantan.
- Local bread purchased from the bakeries outside Kota Bharu, Kelantan.
- Whole wheat or other specialized sandwich bread
- Has meet the expire date

3.5 SAMPLE PREPARATION

The sample preparation includes blending the sample directly after purchasing using Waring Blender Waring 8010S in order to homogenize the sample. The samples were then subjected to proximate analysis starting with moisture content analysis.

3.6 PROXIMATE COMPOSITION OF ANALYSIS

The proximate composition of analysis was conducted using AOAC (1996) for moisture (Air-oven method), total ash, crude protein by nitrogen conversion factor of 5.70 (Kjeldahl method) and crude fat content using the semi-continuous extraction (Soxhlet method). All measurements was carried out in triplicate (n = 3) to determine the average. Total carbohydrates (CHO) was calculated by the difference: total CHO = 100 – (g moisture + g protein + g fat + g ash) (Charrondiere & Burlingame, 2011).

3.6.1 DETERMINATION OF MOISTURE: AIR OVEN METHOD

The homogenized sample was dried in an oven brand Hot Air Oven Memmert 100-800 (at temperature between 105 to 110°C) until constant weight was achieved. After drying of sample, the difference between initial weight and constant weight was recorded. The weight difference was then considered as moisture content of sample. But it should be noted that during drying, other component such as volatile substance might be vaporized together with water. Therefore, the result obtain in this method may not be a precise measurement of the water content of the sample. All measurements was carried out in triplicate (n = 3) to determine the average.

$$moisture, per\ cent\ by\ weight = \frac{loss\ of\ weight\ in\ g\ of\ the\ sample}{weight\ in\ g\ of\ the\ sample\ taken} \times 100$$

3.6.2 DETERMINATION OF TOTAL ASH

Total of ash content represent the total mineral content in foods. Determination of ash is important as it is a first step in the preparation of sample for specific elemental analysis. Sample was incinerated at high temperature by using muffle furnace brand Furnace Barnstead F6020-33 that capable to maintain temperature of 500-600°C.

$$Ash, percent\ by\ weigh = \frac{weight\ of\ ash\ (g)}{weight\ of\ sample\ (g)} \times 100$$

3.6.3 DETERMINATION OF CRUDE FAT: SOXHLET METHOD

The fat content was determined by directly extract the dried sample with petroleum ether in intermittent extraction apparatus of Soxhlet types brand Soxhlet System SER148. The residue remains in the extraction flask after solvent removal will represent the fat content in the sample.

$$\%\ fat\ in\ sample = \frac{weight\ of\ fat\ (g)}{weight\ of\ sample\ (g)} \times 100$$

3.6.4 DETERMINATION OF PROTEIN: KJEDAHL

The semi micro Kjeldahl method is essentially used to determine the total nitrogen content in food. In Kjeldahl method, the sample was oxidized by heating with nitrogen free concentrated sulphuric acid in a long-necked digestive flask with the present of catalyst (copper sulphate, mercury or selenium) using Kjedahl Line Butchi and Kjedahl Line Foss. In this digestion process, nitrogen in the sample was converted into ammonium sulphate. Next, concentrated sodium hydroxide was added to make it the solution alkaline. Then the ammonia steam-distilled and trapped in saturated boric acid solution. The final step was to titrating sample with standard solution of hydrochloric acid and the volume of acid used indicate the amount of ammonia liberated in the sample.

The total protein content in the sample was calculatde by multiply the amount of nitrogen in the sample with specific factor which is 5.70 since most of protein contain 16% of nitrogen.

$$protein, percent = \frac{(ml\ HCl - ml\ HCl\ blank) \times 14.008 \times 0.1N\ HCl \times protein\ factor}{weight\ in\ g\ of\ the\ sample} \times 100$$

3.6.5 DETERMINATION OF CARBOHYDRATE

The amount of carbohydrate in food was determined by calculating the percentage remaining after all other components has been measured.

$$\%\ total\ carbohydrate = 100 - (\%\ moisture + \%\ ash + \%\ fat + \%\ protein)$$

3.7 TEXTURE PROFILE ANALYSIS

The texture profile analysis of bread was performed using a Texture Profile Analyzer TA-XTPlus (Stable Micro Systems, Surrey, UK) together with Texture Exponent Software. The texture parameters measured were hardness, springiness, cohesiveness, and chewiness. Two slices of bread (approximately 40g) with 25-27mm thickness for each sample was put on the base of the instrument (Singh, Jha, Chaudhary, & Upadhyay, 2014). The instrument was equipped with an aluminium probe plate 75 mm diameter (model P/75D). A test speed of 1.0 mm/s, return distance of 3.0 mm with contact force of 3.0 g and 40 % strain was used (Singh et al., 2014). Similar textural profile analysis was conducted for other bread samples in triplicate (n = 3) to determine the average. The firmness, springiness, cohesiveness, and chewiness were calculated from the curves. The definitions and calculations of each parameters are shown as below in Table 2 taken from Handbook Manual of Texture Analyser TA-XTPlus (Stable Micro Systems, Surrey, UK).

No.	Terms	Definitions	Calculations
1	Hardness	Maximum peak positive force during the first compression cycle (first bite).	Unit used is kg.
2	Springiness	Related to the height that the food recovers during the time that elapses between the end of the first bite and the start of the second bite.	*Time diff 4:5 / Time diff 1:2* There are no units for this parameter
3	Cohesiveness	The ratio of the positive force area during the second compression to that during the first compression.	*Area 4:6 / Area 1:3* There are no units for this parameter.
4	Chewiness	The energy required to masticate a solid food. Mastication involves compressing, shearing, piercing, grinding, tearing and cutting, along with adequate lubrication by saliva at body temperature.	Hardness × Cohesiveness × Springiness. Unit used is kg.
5	Gumminess	A characteristic of semisolid foods with a low degree of hardness and a high degree of cohesiveness.	Hardness × Cohesiveness Unit used is kg.

Table 2: The definitions and calculation for Texture Profile Analysis