DEVELOPMENT AND PHYSICOCHEMICAL PROPERTIES OF CHINESE STEAMED BREAD INCORPORATE WITH PARKIA SPECIOSA POD FLOUR

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DEVELOPMENT AND PHYSICOCHEMICAL PROPERTIES OF CHINESE STEAMED BREAD INCORPORATE WITH PARKIA SPECIOSA POD FLOUR

by

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Research Report submitted in partial fulfillment of

the requirement for the degree of

Bachelor of Food Science (Food Technology)

FOOD SCIENCE DEPARTMENT
FACULTY OF AGROTECHNOLOGY AND FOOD SCIENCE OF
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ENDORSEMENT

The project report entitled **Development and Physicochemical Properties of Chinese Steamed Bread Incorporated with Parkia Speciosa Pod Flour,** by **Wan Maisara Binti Wan Kamarudin,** Matric No. **UK 18022** has been reviewed and corrections have been made according to the recommendations by examiners. This report is submitted to the Department of **Food Science** in partial fulfillment of the requirement of the degree of **Bachelor of Food Science of Food Technology**, Faculty Agrotechnology and Food Science, University Malaysia Terengganu.

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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ABSTRACT

This study was conducted in order to determine the effect of the incorporation of the 'petai' (*Parkia Speciosa hassk)* to the properties of Chinese Steamed Bread (CSB). PSP flour actually one of the product that can be produced from *P. Speciosa* and had a potential to substitute wheat flour because it is high in diet fiber, antioxidant, and vitamin. In this study, *P. Speciosa* flour (PSP) was produced, followed by production of Chinese steamed bread that was incorporated with the highly fiber content of flour. In the Chinese steamed bread production, standard wheat flour was been substitute with the PSP flour. Once the Chinese steamed bread were finished, proximate analysis, quality assessment and sensory evaluation were conducted. Range of proximate composition of the Chinese steamed bread samples were moisture content (20.450%-25.365%), protein content (4.795%- 7.395%), fat content (2.125%-4.390%), fiber content (1.470%- 4.850%) and ash content (0.41%- 0.755%). Chinese steamed bread that incorporated with the PSP flour have the colour more darker than the CSB that used the wheat flour, because it have positive value for whiteness. CSB that incorporated with the PSP flour was most acceptable in most (color, odor, hardness, elasticity, chewiness and overall acceptance) in terms of panelist acceptance.

ABSTRAK

Kajian ini di jalankan bertujuan untuk mengenalpasti kesan penggunaan tepung petai (*P.Speciosa Hassk*) terhadap ciri- ciri roti pau. Tepung petai ini merupakan salah satu produk yang boleh dihasilkan daripada kulit petai dan berpotensi untuk menggantikan tepung gandum kerana tepung petai ini mempunyai kandungan fiber, anti-oksidan dan vitamin yang lebih tinggi berbanding tepung gandum biasa. Dalam kajian ini, tepung petai dihasilkan terlebih dahulu dan di ikuti penghasilan roti pau. Lima sampel roti pau telah di hasilkan dengan kandungan tepung petai yang berbeza (0.2%, 0.4%, 0.6%, 0.8%). Petai yang segar dibeli diproses menjadi tepung dan disimpan pada suhu bilik. Kemudian, roti pau yang di hasilkan dan kandungan tepung petai telah di campurkan dengan sebanyak mana seperti yang telah di tetapkan dalam formulasi. Kemudian, roti pau yang telah siap di hasilkan itu di teruskan lagi dengan analisis komposisi proksimat, penilaian kualiti dan juga penilaian pengguna ke atas roti pau yang telah di campurkan tepungnya dengan tepung petai dalam proses penghasilan itu. Didapati kandungan kelembapan (20.45%-25.365%), kandungan protein (4.795%- 7.395%), kandungan lemak (2.125%- 4.390%), kandungan fiber (1.470%- 4.850%) dan kandungan abu (0.41%- 0.755%). Roti pau yang menggunakan tepung petai mampunyai keputihan yang kurang berbanding roti pau yang menggunakan tepung gandum biasa. Ini dapat dilihat melalui nilai positif yang didapati dan nilai yang lebih rendah untuk ciri keputihan. Roti pau yang dihasilkan dengan campuran tepung petai ini lebih diterima dari segi warna, bau, kekerasan, kekenyalan dan penerimaan keseluruhan berdasarkan panel.

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CHAPTER 1

INTRODUCTION

1.5 Background of Study

Chinese steamed bread (CSB) originated in China 1700 years ago. During its long-term development, numerous unique types of CSB have appeared, among which the most representative types are northern-style and southern-style steamed bread. CSB is the most popular wheat product in China. CSB represents approximately 40% of wheat consumption throughout China, and about 2/3 in northern China. At present, northern-style CSB is primarily made by hand. Although CSB is a very important food item in China, genetic studies on CSB-making quality are rare. Most of authors have reported relationships that are important in wheat quality, especially protein traits and CSB-making quality, using various wheat cultivars and flours (Addo et al., 1991).

Results showed that medium levels of protein and gluten strength are suitable for making northern-style CSB. Chinese steamed bread (CSB), a kind of wheat-based traditional fermented Chinese food has been consumed for almost two millennia in China (Su, Ding, Li, Su, & Zheng, 2005). It is gaining popularity and widely consumed by people reside in the Southeast Asia region. The basic ingredients for making CSB are wheat flour, water, yeast and salt; sugar and shortening are optional (Pomeranz, Huang, & Rubenthaler, 1991). There are three major types of steamed bread made in China. The Northern-style steamed bread has a very cohesive, elastic and dense texture and it is usually prepared from strong gluten flour. Whereas, the Southern-style steamed bread, is commonly known for a more open crumb structure, softer texture and a white surface, and it is usually prepared from weak gluten flour. In the very southern part of China, Cantonese-style steamed bread or bun is popular.

This type of steamed bread is very unique whereby the crumb is extremely white in colour, very soft but not cohesive in texture and tastes very sweet (Crosbie, Huang, & Barclay, 1998). Usually, the consumers prefer steamed bread which has a smooth surface, a soft, moist, and uniform white crumb with higher specific volume (Rubenthaler, Huang, & Pomeranz, 1990). The processing method of CSB is different from that of bread, where the CSB is made by cooking the fermented dough through steaming whereas bread is produced by baking in an oven.

This steaming method produces product with a soft, moist, and uniform crumb texture, and a thin, smooth, white skin rather than the brown crust of traditional bread (Rubenthaler et al., 1990). Qin, Cheng, and Ma (2007) reported that the shelf life of CSB was 1 to 3 days only when being stored at room temperature and the shelf life becomes shorter at higher storage temperature or reduced storage relative humidity. On the other hand, most of the time bread quality loss is not due to microorganism or endogenous enzyme deteriorative activity but staling (Bárcenas & Rosell, 2005). CSB usually been made by various types of flour, dry yeast, shortening, baking powder, warm water and castor sugar. Normally, we used white flour to make CSB such as Pau Flour or Hong

Kong Flour to make this CSB. However, this CSB we do the improvements where we used the other types of flour, where the flour that we used is totally made from *Parkia Speciosa* pod (PSP). The CSB is made by the incorporation with the PSP flour.

P. speciosa Hassk is known as stink bean or "petai". It bears long and flat beans pod with green seeds. These beans are popular in Southeastern Asia including Malaysia, and Northeastern India. They are sold in the pods or the seeds are already separated from the pods. They are also pickled in brine and exported in jars. *P. speciosa* is also believed by the locals to have medicinal properties. Jamaluddin, Mohamed, and Lajis (1994, 1995) have reported the hypoglycemia activity of the pod and seed using alloxan diabetic rats. Other research showed that *P. speciosa* seeds contain antibacterial cyclic polysulfides (e.g. hexathionane, tetrathiane, trithiolane, pentathiepane, pentathiocane and tetrathiepane) which are also responsible for their pungent flavor. This search for plant-derived biomaterials has therefore stimulated research interest in producing functional fibres from under-utilized bulk agrowaste, such as *Parkia speciosa* empty pod (PSP).

In the process of making flour, the PSP is dried in order to reduce the bacterial growth in the product. By doing this, the amount of water presence in the PSP can be reduced thus prolong the shelf life of the flour, and also can prevent from the mould or other organisms contaminate to the flour directly give good quality of flour in making good quality of CSB. In addition, the steaming method that we used in making CSB also in-cooperate in giving the good quality of CSB. The main ingredient that we used is PSP flour. PSP flour is 100% made from *P. speciosa* pod. *Parkia speciosa* is a local product. Thus, by using it, we can promote our local products on the market at the same time give variety to people who love to eat *P. speciosa*. Our target market is people who really love

P. speciosa and can take it different ways by eating CSB that is produced using the PSP flour other than as a vegetables and eat with rice.

1.6 Problem Statement

Chinese Steamed Bread (CSB) required long time preparation. Normally, it is only consumed traditionally by Chinese as a breakfast, because the bun is relatively simple (Robert Andre LaFleur, 2003). Raw materials that are needed to make this steamed bread are easy to buy but need to keep it in good condition in order to produce nice and good texture of dough. The dough need to be proof for approximately 30 to 40 minutes in order for yeast to undergo fermentation process which will produce the CO_2 that will trapped by the gluten formation in the dough. Besides, the busy life styles resulted to limited time to prepare meal at home, thus contribute to the high demand on ready-to-eat food, where steamed bun also could get in the frozen one which normally could keep it up to months and only need 10 to 15 minutes to cook it. In addition, limited variety of steamed bun flavor in the market also contributes to this study. Besides that, there is no research done by using the *P. speciosa* pod (PSP) flour incorporation in steamed product also contributes to this research. Due to the high nutritional value, *P. speciosa* can be a potential functional ingredient in a daily cooking. For the most important one is because the PSP is a waste product. The food industry is experiencing a constantly growing demand for new ingredients from natural resources. This demand has therefore drawn researchers to these ingredients obtained from agro industrial waste

(Guerrero, Torres, & Nuñez, 2008). In developing and developed countries alike, of the potentials of the agrowaste derived material has also called for new research approaches to the exploitation of the agrowaste. In addition, plant-derived materials are now regarded as versatile functional ingredients and biologically active components (Biliaderis & Izydorczyk, 2007). A diet rich in plant materials is also believed to protect against a wide range of diseases such as constipation diverticular disease, colon rectal diseases, diabetes, obesity, gall stones and colon cancer (Biliaderis & Izydorczyk, 2007).

1.3 Justification

Even though the steamed bread is mostly consumed during breakfast for the Chinese cuisine, however it is not too familiar for the Malay and Indian. Besides, the steamed bread (CSB) is easy to get in Kelantan and Terengganu. Normally it will be consumed as snack during the tea time. Therefore, the development of steamed bread from PSP flour will might increase the consumption of traditional dishes not only among Chinese but also by other community as a variety in flavor at the same time promoting of our local product in food variation and obtaining benefits from their consumption and do developing product with high in fiber and protein with variety of taste. By doing this research, it will gives advantage to the environment and consumer when we optimize the usage of the waste by using the PSP to make the flour. At the same time could produce a balanced healthy diet of Chinese steamed bread.

1.4 Objectives

a) To determine the effect of incorporation of *P. speciosa* pod (PSP) flour on physical properties of Chinese steamed bread in terms of texture, volume and color.

b) To determine the effect of incorporation of *P. speciosa* pod (PSP) flour on the properties of Chinese steamed bread on chemical analysis.

c) To determine the sensory acceptance of Chinese steamed bread (CSB) incorporated with *P. speciosa* pod (PSP) flour.

CHAPTER 2

LITERATURE VIEW

2.1 Petai (*Parkia Speciosa*)

The food industry is experiencing a constantly growing demand for new ingredients from natural sources. This demand has therefore drawn researchers to these ingredients obtained from agroindustrial waste (Masmoudi et al., 2008). Expanding the potentials of the agrowaste derived material has also called for new research approaches to the exploitation of the agrowaste. In addition, plant-derived materials are now regarded as versatile functional ingredients and biologically active components (Biliaderis & Izydorczyk, 2007).

Among these popular plant materials that have been widely used in food industry are non-starch polysaccharide food reserve materials (e.g. locust bean gum, guar gum), cell wall materials of seed cotyledons and endosperms (e.g. xyloglucan from Tamarind seed and soluble soybean polysaccharide) and mucilages in seed coat (e.g. psyllium mucilage). These plant materials found broad applications in the areas of foods (e.g. as thickener, gelling agent, emulsifier, coating, fat substitute) and pharmaceuticals (e.g. radical-scavenging agent, diet supplement) (Castro, Tirapegui, & Benedicto, 2003). Kuan and Liong (2008) also found that agrowaste fibrous materials from okara, corn cob, wheat straw and rice husk obtained high water- and oil-holding capacities as well as emulsifying activity. They suggested that these agrowaste materials could be utilized as functional food ingredients. A diet rich in plant materials is also believed to protect against a wide range of diseases such as constipation, diverticular disease, colon-rectal diseases, diabetes, obesity, gall stones and colon cancer (Biliaderis & Izydorczyk, 2007). This search for plant-derived biomaterials has therefore stimulated research interest in producing functional fibres from under-utilized bulk agrowaste, such as *P. speciosa* empty pod.

P. speciosa is known as stink bean or "petai". It bears long and flat beans pod with green seeds. These beans are popular in Southeastern Asia including Malaysia, and Northeastern India. They are sold in the pods or the seeds are already separated from the pods. They are also pickled in brine and exported in jars. *P. speciosa* is also believed by the locals to have medicinal properties. Jamaluddin, Mohamed, and Lajis (1994, 1995) have reported the hypoglycemia activity of the pod and seed using alloxan diabetic rats. Other research showed that *P. speciosa* seeds contain antibacterial cyclic polysulfides (e.g. hexathionane, tetrathiane, trithiolane, pentathiepane, pentathiocane and tetrathiepane) which are also responsible for their strong pungent flavour.

P. speciosa is a Southeast Asian legume of the *Mimosae* subfamily. *P. speciosa* normally can grow up to 30 m tall or more. It has smooth light colored bark. Leaves are alternate in arrangement, bipinnate, 18- 30cm long. Leaf of stalk is about 2-6cm long. It's has a flowers that are very small, many flowers together on the pear-shaped fleshy tip of the inflorescence stalk that is 20-45cm long. The upper portion has bisexual flowers while the lower portion has asexual or male flowers. Fruit is a legume 34-45cm, 3-6cm wide, with 12-18 seeds. There are a number of varieties within this species with different sizes of fruits, seeds, texture of seeds and taste. A number of other species of *P. speciosa* are also used as food on have the same vernacular name. The seeds contain about 70% water, 11-17% carbohydrate, 9% protein, 1.8-8% fat, 1% fibre, alkaloids, calcium, cystine, iron, lectin, phosphorus, potassium, sulphur compounds, tannin, thioproline, pro-vitamin A, vitamin B, vitamin B_2, vitamin B_3 and vitamin C.

Flowering after about five years. The fruits ripen 60-70 days after flowering. It can be planted from sea level until 1500m altitude. Where the disease and pests are the serious damage or death may be cause by bark and stem borers *Cossos Subfuscus* and *Xystrocera Festiva* . Fruits are also face damage by the borers *Cryptophelebia Ombrodelta* and *Mussidia Pectinicornella*. However, the leaves may be eaten by the caterpillars of *Eurema Blanda, E. Hecabe* and *Polyura Hebe.* The seeds are eaten by squirrels. The fruits are damaged or plucked by monkeys (Ong, 2008).

Usually the seeds are consumed as a condiment or vegetable with rice, for its unique shiitake mushroom- like flavor. When taken in excess it gives a strong onion-like smell, which is excreted by the body in the urine, the swat and the feces. Sometimes, *P. speciosa* is eaten because is believed to have anti-diabetic and anti-hypertensive activity. *P. speciosa* has been used in traditional medicine for its antibacterial effects on kidney, ureter and urinary bladder. The antibacterial and antifungal compounds were found to be cyclic polysilfides,whose structures were established as 1,2,4- trithiolane, 1,2,4,6-tetrathiopane, 1,2,3,5,6- pentathiepane(lenthio-nine), 1,2,4,5,7,8- hexathionate and pentathiocane (Gmelin et al., 1981). D-ischrostochinic acid, djenkolic acid and thiozolidinea-4- carboxylic acid were also identified (Holzman et al., 1982). Thiozolidine-4- carboxylic acid has been successfully used experimentally and clinically as an anti-cancer agent (Pandeya, 1972). Djenkolic acid has been known to cause black age of the urinary tubules due to its low solubility, resulting in pain, haematuria and even death. *P. Speciosa* seeds, also contain significant minerals, vitamins, proteins and fat, while having a lower antinutrient content compared to soya bean (Suhaila et al., 1987). This research was undertaken to investigate the physicochemical properties of CSB when it is incorporated with PSP flour.

2.2 Vegetables

Vegetables are important for health. So are fruits, complex carbohydrates and some protein. Food from the plant kingdom has always been important to human with some exceptions where animal meat is the main food. Most research shows that a balanced diet is of utmost importance for health. Consuming food mainly made of only one food group has been shown to be associated with various health problems. Research has shown that excessive fat consumption is linked with cancers of the breast, colon, prostate, and rectum. A diet low in fiber is linked with colon cancer. Antioxidants are taken regularly is shown to reduce the incidence of cancers of esophagus and stomach. Food intolerances are linked to allergies, flatulence, rheumatoid arthritis, stomach ache. Eating food from plant source without variety can also be hazardous to health. For instance, prolonged regular consumption of maize with little protein intake has been linked to pellagra, a chronic disease due to deficiency of nicrotinic acid causing gastrointestinal disorders, skin eruptions and nervous disorder. There are many types of diets or food formulas for health, healing or losing weight.

Vegetables owe their healing properties to the presence of various materials that are absorbed and used by the human body for various bodily functions and for healing. These components are placed in two groups, the nutritional constituents and the medicinal constituents but there are overlaps and different opinions. How can vegetables have medicinal properties? It is because of the substrates within the vegetables that give them certain healing and preventive properties.

Vegetables with healing and health properties are not a simple case of one active ingredient being important, while the rest of the constituents are neutral or unnecessary. Very often, the mixture of many constituents in a particular vegetables or a number of vegetables will have different effects from the sum total of the effect of the individual constituents. Substances that are of little or no value on an individual basis may act together providing health or healing properties. A substance that is harmful when used on its combination with others may become beneficial for health. However, substances that are beneficial within the combination may be harmful in large doses its purified form.

Vegetables contain substrates that are placed in specific groups called carbohydrates, protein, fat, fibers, minerals, vitamins and various chemical compounds which have their own grouping such as alkaloids, essentials oils, saponins and tannins. A large portion of fresh vegetables is made up water which is also very important as cannot exist without water. Food provides the fuel for the body function. Nutrients and other chemicals from food are vital for the body to function efficiently and fight infections; as building blocks for the body to grow, repair and renew cells, tissues and even parts of organs. Food also provides roughage which enables the bowels to function properly and regularly. Minerals and vitamins are placed here under nutritive but they are also used in healing. Minerals may be considered as medicinal by some and nutrition by others. Minerals and vitamins are required for normal growth so they are nutritional. Minerals and vitamins are also used in treating certain elements so they are then medicinal.

2.3 Carbohydrate

Carbohydrates are the main source of energy for most human, many types of animals and all plants. The most common forms of carbohydrates in food are sugar and starch. Most vegetables contain sugars even though they may not taste sweet. Some vegetables contain more sugar than others but we are not likely to consume too much sugar by eating more vegetables. A little sugar does not harm as sugar is a source of energy for body functions.

The body also converts starch into sugar to be used as energy. Consumption of sugar in drinks and food will rapidly increase the level of sugar in the blood and it is available to be converted into energy or stored. People who have diabetes or who obese should avoid or minimize the intake of sugars so that blood sugar levels will not rise suddenly and then fall. High sugars levels in the blood will demand more insulin to convert the sugar into energy. High insulin levels in the blood is linked to disorders such as abdominal obesity, higher levels of blood fats and higher levels of estrogen which in turn increases the risk of breast cancer.

2.4 Wheat Flour

Wheat flour comes from the starch rich endosperm of wheat plant. The endosperm contains the stored food for the plant, represents over 80- 85% of the weight of the kernel (Cauvian, 2003). Moreover, the endosperms contain albumins, globulins and the major proteins of the glutens complex which are glutenins and gliadins. The protein storage of the wheat usually make up about 10- 14% of the weight of the kernel (Cauvian, 2003). The glutenins function as to form an extensive three- dimensional network of molecules through disulfide bonding, hydrogen bonding and hydrophobic interactions. The gliadins are also important for the network reactions.

Wheat carbohydrate consists of polymers amylase and amylopectin which can be classified as D-glycans or more specifically, D- glucans since they are polymers of glucose. The amylase content of the most natural starches is around 25% (Cauvian, 2003). Intact starch granules are almost insoluble in water, but the granules do swell because of the disruption of surface membranes. This starch is able to form paste on heating in water. During heating, the starch granule swell and the straight chain diffuse out. Another type of carbohydrate, cellulose consists about 3% of wheat (Toep et al., 1972). Wheat will go through milling process to make it into flour by isolating the starchy endosperm from the kernel. Mechanically, milling process damages some of the starch granules in wheat flour. These damages starch granules have higher water holding capacity at room temperature than native undamaged starch granules (Delcour and Hoseney, 2009). Table2.1 shows the amino acid content of wheat flour.

Amino Acid	Content	Recovery in Flour(%)
Histidine (E)	0.36	85
Ammonia	0.55	106
Arginine (E)	0.76	72
Aspartic acid/asparagines	0.79	76
Theconine	0.47	86
Serine	0.83	95
Glutamic acid/glutamine	4.98(30.2%)	103
Praline	1.62 (9.8%)	110
Glycine	0.65	80
Alanine	0.56	79
Cystine	0.31	94
Valine(E)	0.74	90
Methionine	0.25	103
Isoleucine(E)	0.62	98
Leucine (E)	1.07(6.5%)	97
Tyrosine	0.46	94
Phenylalanine(E)	0.77	101
Tryptophan(E)	0.27	83
Total	16.49	

Table 2.1 : Amino Acid (E signifies essential amino acid) levels in hard red wheat (% by dry weight) and recoveries in flour (% of wheat)

Source : Teopfer et al., (1972)

There are large differences between the levels of some amino acids in the aleurone layer and those in the flour. Functional properties of proteins, such as solubility, water absorption and binding, viscosity, gelation, cohesion-adhesion, elasticity, emulsification, fat absorption, flavor binding, foaming and color control (Kinsella, 1979) are influenced by agronomic factors, storage, composition and processing (Cherry et al., 1979)

Lipids are minor components of the wheat flour with function in the wheat end-use quality. Total lipids account for 3-4% of the wheat kernels and about 45% of these are located in the starchy endosperm (Chung, 1986). Generally, the content of lipids in the wheat flour is between 1.5% and 2.0% and most of them are contributed from the endosperm while others are from germ and aleurone in the tissue fragments. Basically, lipid in wheat can be grouped into three categories, which are non-starch lipids, starch lipids and starch surface lipids according to their location in flour components (Pomeranz, 1988). Between these lipids in wheat, non- starchy lipids have attracted more interest because their end-use quality of wheat flour use has been recognized (san et al., 2010).

Basically, soluble fiber made up of 40 to 50% of the total dietary in the wheat flour (Wang et al., 1991). Table 2.2 below shows the proximate composition of the wheat flour.

Constituent	Percent (%)
Moisture	12.5
Ash	1.2
Protein (N x 5.7)	13.1
Fat	1.6
Fiber	2.0
Carbohydrate	69.6

Table 2.2 Proximate chemical composition of wheat flour (all purpose of flour)

Source: Tee et al., (2008)

Table 2.3 below shows common types of wheat flour that are usually used

Flour type	Description
All purpose flour	It is blend and soft wheat flour. All purpose flour has a wide range of uses and works well in breads or pastries. Some manufacturers often bleach it to whiten it which results in more gluten, while unbleached flours have more flavors.
Bread flour	Specially flour used for bread making. This flour has higher gluten content between 12.5 to 14%.
Cake flour	It is made exclusively from soft wheat. This refined flour gives a cake light, soft texture because it has low gluten content and cannot be used to make raised breads.
Durum flour	It is made from hard wheat and it is often used in pasta because it has high gluten content
Gluten flour	This flour undergoes a manufacturing process so that its gluten has about twice the strength of regular flour.
Self rising flour	This flour contains salt and a leavening agent, such as baking soda. It should not be used in yeast breads
Whole- wheat or Whole- grain flour	This is flour that has the wheat germ and bran that were removed during milling added back before it is packaged for consumers. Sometimes this called graham flour. This type of flour is high in nutrients.

Table 2.3: Types of wheat Flour

Source: Encyclopedia of Food (2002)

There were reported that lipids did a role in the baking quality (Hannah, O'Brien, & Bekes, 1993). It have been reported that removal of flour lipids caused a reduction in bread loaf volume and also in crumb grain score, compared with bread- baking quality, studies of the effects of flour of lipids on other flour products have been much fewer. Other than that, Pomeranz, Huang and Rubenthaler (1991) state that defatting significantly reduced volume and softness of steamed- bread (called Mantou in China). Two properties are required for good performance of bread dough: optimum rheological properties and a stable gas cell structure. It is believed that lipids play an important role in maintaining a stable gas structure via its interaction with protein at the gas or liquid interface of liquid lamellae surrounding gas cells in the bread dough. Crosbie, (1991) state that most studies related to lipid functionality in wheat flour have focused on bread- baking quality, for which protein is the most essential ingredient. A good deal of evidence has shown that starch quality is also very important for oriental flour foods, like steamed- bread and noodles.

The Chinese wheat growing areas are generally divided into the spring-sown and autumn-sown wheat regions. Spring-sown wheat (SSW) occupies about 15% of the national wheat area and contributes around 12% of total production (Zhang et al., 2004). Most of SSW production is consumed locally; therefore, quality improvement efforts have been targeted at northern-style Chinese steamed bread (CSB) and Chinese noodles, which are the dominant products in SSW region. Chinese wheat is well known for its weak dough properties, and improvement of dough strength has been a major breeding objective across all China including the SSW region (He et al., 2003). Both protein fractions and composition of glutenin subunit affect dough strength and end-use quality (He et al., 2005). Wieser, (1994) indicate that protein fractions are significantly affected by genotype, environment, and genotype-by-environment, but glutenin subunits are determined by genotype. On the other hand Gupta et al., (1991) state that several high molecular weight glutenin subunits (HMWGS) such as 5+10, low molecular weight glutenin subunits (LMW-GS), and gliadin have been associated with dough strength, and bread-making quality. The amount of glutenin subunits was positively correlated with dough strength, and loaf volume, whereas the amount of gliadin and higher gliadin:glutenin ratios had a negative effect on these parameters (Singh et al., 1990). For the high HMW-GS:LMW-GS ratios were significantly correlated with dough strength and loaf volume (Uthayakumaran et al., 2000).

Different gliadin fractions also affect loaf volume (Weegles et al., 1994). g-gliadins peak areas obtained from reversed-phase highperformance liquid chromatography (RP-HPLC) were correlated with loaf volume, with correlation coefficients of 0.93–0.99 for different cultivars (Huebner et al., 1997). CSB represents more than 40% of Chinese wheat consumption (He et al., 2003). The flour quality requirement for CSB is different from that of pan bread. Generally, medium to strong strength flour is desirable (Huang et al., 1996). CSB quality was positively correlated with protein content and gluten strength (He et al., 2003), whereas protein content had a negative effect on CSB quality for flour sourced from hard red spring wheat (Rubenthaler et al., 1992).

Huang et al., (1996) state that flour protein content can be negatively or positively correlated with CSB quality, depending on protein content and differences in dough strength. CSB flour quality requirements also depend on the processing conditions; medium protein content and medium- to-strong gluten strength with good extensibility is desirable for mechanized methods, but weak-to-medium gluten strength is preferred for manual methods (He et al., 2003). Huang et al., (1996) and He et al., (2003) reported that

CSB quality was also determined by other flour properties, such as flour whiteness, RVA peak viscosity, and ash content. The 1B/1R translocation has a negative effect on end-use quality (He et al., 2005). It decreases the quantity of LMW-GS and increases the quantity of o-gliadins, causing changes in the proportions of polymeric and monomeric proteins of gluten (Dhaliwal and MacRitchie, 1990; Wieser et al., 2000). However, the negative effects of 1B/1R translocation on end-use quality can also be modified by the genetic background such that lines with optimal HMW-GS will still perform in a satisfactory manner (Graybosch, 2001; Graybosch et al., 1990; Pen˜ a et al., 1990).

2.4.1 Wheat enzymes

The performance of wheat flour is influenced by several wheat enzymes especially in bread making. The enzymes that influenced most are amylases and proteases. The amylase is a hydrolase that catalyze the hydrolysis of the polysaccharide. One of the main enzymes of this type is α- amylase. During bread making, it reacts slowly with starch granules, but rapidly with gelatinized starch to produce a mixture of dextrin, other oligosaccharides and small amounts of maltose. Next, proteases in wheat flour will reduce the consistency of the dough after mixing and resting processes.

2.5 Chinese Steamed Bread

The important quality for the Chinese steamed bread is that to have smooth and blister-free external surface (Huang et al., 1993). Quality requirement for Chinese steamed bread are different from those of pan breads, including distinct attributes of elasticity, stickiness and smooth appearance (He et al., 2003). The addition of water in dough in Chinese steamed bread is lower than that of western bun making with only 40-50% of flour weight basis (Rubenthaler et al., 1990).

Hence the dough for Chinese steamed bread making is stiffer and firmer than the dough for western bread making (Su et al., 2005). Wheat flour is usually used in bread making due to the ability to form a viscoelastic network when mixed with water (Dervas et al., 1998). This network is usually called 'gluten' which has the ability to trap gases produced during fermentation, proofing and heating process. These processes allow the dough to expand to become softer and lighter bread after the heat treatment process. The higher the protein content of the flour, the better is its ability to traps and retain carbon-dioxide gas and the larger can be the bread volume (Cauvian, 1995). Table 2.4 below shows the amounts of constituents that contribute to the good quality of bread.

Constituents	Percent (%)
Starch	70- 80%
Proteins	8- 18%
Lipids	Approximately 2%
Pentose	Approximately 2 %
Enzyme and enzyme inhibitors	-
Minor compounds	-

Table 2.4: The amount of constituents that give good bread quality

Source: Pomeranz, (1998).

Previous researches have been suggested that, there are no correlation between steamed bread quality and flour quality (Zhang and Wang, 1987). But there are other researchers had been suggested that there are significant and positive correlation between protein content and volume of steamed bun (Addo et al., 1991). On the other hand, Lukow et al., (1990) also suggested that steamed bread quality is positively correlated with protein content and gluten strength of wheat flour used. While, according to the Huang et al., (1996), steamed bread quality is independent on flour protein content as flour protein content increase beyond 10%. The contrasting reports may be due to the use of different types of flour, laboratory processing and evaluation procedures. In terms of fat, defatting will significantly reduce the volume and softness of steamed bun (Pomeranz et al., 1991). It is believe that lipids play an important role in maintaining a stable gas cell structure via its interaction with protein at the gas and lipid interface of liquid lamellae surrounding gas cells in the bread dough (Sun 2010). But, recent study has shown that there is no significant deterioration effect on the volume of softness of Chinese steamed bun by defatting (Sun et al., 2009). Furthermore, he also suggests that is may be due to the difference in formulation. Meanwhile, previous study has shown that shortening could impact on lipid extraction on yeast raised products (MacRitchie & Gras, 1993).

The larger the proportion of damage starches the higher water absorption of the flour (Stauffer, 1998). The properties of the dough will vary according to the level of added water. When there is too little water have been added, the dough will be firm and difficult to mould (Cauvin and Young, 2001), thus producing breads that have small volume and poor external appearance.

Knorr and Betschart, (1978) suggest that added foreign protein will have the weakening effect on the wheat flour dough due to the dilutions of gluten structure. This will be result in lower volume and has negative effects on the other quality attributes such as tenderness. Indeed, the ability of the wheat flour to form visco-elastic dough with gas-holding properties is primarily due to the gluten proteins. When heating, starch gelatinization occurs where the structural orders of starch granules are irreversibly destroyed.

The combination of heat, moisture and time during heating induces starch gelatinization and pasting which start at about 65° C (Goesaert, 2009). The partially crystalline starch is then transformed into completely amorphous, gelatinized starch entanglement networks (Hoseney, Sievert and Delcour, 2008). Generally, flour quality requirements for steamed bun include low α- amylase activity, white color and low level of damaged starch (Crosbie, Huang, and Barclay, 1998). For Northern style steamed bread, flour with 10.0- 12.9% protein with medium to strong dough properties is preferred. While for Southern steamed bread, flour with about 9.5 – 11.0% protein with medium strength is favored. Low protein flour about 9.5 – 11.0% with very white color and weak to medium strength shows more suitable for Cantonese style bun (Crosbie, Huang and Barclay, 1998).

According to Cauvian and Young (2007), there are several steps in bread making as follows:

Mixing of flour, water and yeast and other ingredients in appropriate ratios

↓

Development of gluten structure in the dough through the application of energy during mixing or kneading

↓

Incorporation of air bubble within the dough during mixing

↓

Continue development of gluten structure in order to modify the rheological properties of the dough and to improve its stability to expand when gas pressure increase because of the generation of carbon dioxide gas in the fermenting dough, this stage also can be referred to as 'ripening' or ' maturing' of the dough

↓

Creation or modification of particular flavor compounds in the dough

↓

Divisions of the dough into unit pieces

↓

Preliminary shape modification of divided dough pieces

↓

Final shaping to achieve their required configurations

↓

Fermentation and expansions of the dough pieces during 'proofing' process

↓

Further expansion of the dough pieces and fixation of the final bread structure during heat treatment

Figure 2.1: Steps in bread making

Source: Cauvian and Young (2007)

During fermentation process, softer dough will be produced. The longer fermentation time, the softer and lower the adhesiveness of the dough. Therefore, the addition of yeast will increase the specific volume, spread ratio and decrease the crumb softness. But, there is no significant effect on elasticity of the bun (Su et al., 2005). Furthermore, fiber content in the bun will also affect the chemical reaction during the bun making. For example, soluble fiber water binding capacity and interaction with cross-linking materials will affect starch gelatinization. This is because dietary fiber addition can delay both gelatinization and retrogradation kinetics. Nevertheless, this depends on the ratio of insoluble to soluble fibers and insoluble fibers can retard the kinetics for amylopectin retrogradation (Santos et al., 2008)

Proofing is the name given to the dough resting period after the shaped pieces have been put into tins or placed trays during which fermentation continues in a controlled atmosphere, typically 40- 45^{o} C and 85% relative humidity (Cauvian, 2003). Baker's yeast is at its most active at 35 to 40^{o} C and so running the power around 40^{o} C minimizes the time required for proofing process (Cauvian, 2003). During proofing process, the starch from the flour is progressively converted into dextrins and sugars by enzyme action. Then, yeast will use the sugar to produce carbon dioxide and alcohol. As dough warms up, it goes through a complex progression of physical, chemical and biochemical changes. Yeast activity decrease from 43^{o}C and ceases by 55^{o} C. while gelatinization of the starch starts at about 60^{o} C and it will absorb any free water in the dough (Cauvian, 2003)

2.6 Drying Process

Drying is a mass transfer process consisting of the removal of water moisture or moisture from another solvent, by evaporation from a solid, semi-solid or liquid. To be considered as "drying", the final product must be a solid. To achieve this, there must be a source of heat, and a sink of the vapour thus produced. In bioproducts (food, grains, vaccines), and pharmaceuticals, the solvent to be removed is almost invariably water. In the most common case, a gas stream like air, applies the heat by convection and carries away the vapor as humidity.

Other possibilities are vacuum drying, where heat is supplied by conduction or radiation (or microwaves) while the vapor thus produced is removed by the vacuum system. Another indirect technique is drum drying (used, for instance, for manufacturing potato flakes), where a heated surface is used to provide the energy and aspirators draw the vapour outside the room. In some products having high initial moisture content, an initial linear reduction of the average product moisture content as a function of time may be observed for a short time.

If drying is continued, the slope of the curve, the drying rate, becomes less steep (falling rate period) and eventually tends to a horizontal, at very long times, to become in equilibrium with the dehydrating medium. In the falling rate period, water migration from the product interior to the surface is mostly by molecular diffusion, the water flux is proportional to the moisture content gradient. This means that water moves from zones with higher moisture content to zones with lower values, a phenomenon explained by the second law of thermodynamics. If water removal is considerable, products undergo shrinkage and deformation, except in a well designed freeze drying process.

Basically, drying is the oldest method of preserving food and it is quite simple. Dried foods keep well because the moisture content is so low that spoilage organisms cannot grow. Drying will never replace canning and freezing because these methods do a better job of retaining the taste, appearance, and nutritive value of fresh food. But drying is an excellent way to preserve foods that can add variety to meals and provide delicious, nutritious snacks. In addition, for a good-quality product, vegetables and fruits must be prepared for drying as soon as possible after harvesting. They should be blanched, cooled, and laid out to dry without delay. Foods should be dried rapidly, but not so fast that the outside becomes hard before the moisture inside has a chance to evaporate.

During the first part of the drying process, the air temperature can be relatively high, that is, 150ºF to 160ºF which is (65ºC to 70º C.) So, that moisture can evaporate quickly from the food. Because food loses heat during rapid evaporation, the air temperature can be high without increasing the temperature of the food. But as soon as surface moisture is lost and the outside begins to feel dry and the rate of evaporation slows down, the food warms up. The air temperature must then be reduced to about 60ºC.

2.7 Milling Process

Bread quality is only partly dependent on the quality parameters related to the raw material. The quality of bread is a complex concept influenced by many factors operating on three levels: quality of wheat, properties of flour and the baking procedures employed. Handling of material, from wheat to bread, brings substantial variation to the final product, and alternative milling and baking techniques may induce considerable variation. Milling is a technological process and the milling effects on flour characteristics are well known (Cornell and Hoveling, 1998) although the effects on the sensory qualities of the bread have not been described.

There is a comprehensive body of literature on dough quality, the chemical composition of wheat and the physics of bread making. However, few studies have dealt with the effects of production quality (type of farming system) on the sensory qualities of whole meal wheat bread. It was found that whole wheat bread baked with flour from organically grown wheat samples was drier and less elastic than bread baked with flour from conventionally grown wheat.

Moreover, it was stated that there was lower protein content in the organically grown wheat than in the conventionally grown wheat, and that the volume of the whole meal bread was lower for the bread baked with flour from organically grown wheat than for that baked with flour from conventionally grown wheat (Haglund et al., 1998). In Sweden, several milling techniques are commonly used. In the milling industry, roller-mills have mostly replaced traditional stone-mills, however, both types of mills are still used. As the concepts behind the milling techniques differ extensively (Jones and Ziegler, 1964), flour of different baking quality would be expected, even using the same wheat sample and the same extraction rate.

The aim of milling in a roller-mill is a gradual reduction of the endosperm to desired particle sizes, after the bran and germ have been separated from the endosperm (Ziegler and Greer, 1971). The final composition of the flour is achieved through blending of different flour fractions to produce a desired flour quality. Stone-milling involves grinding of the wheat kernels between two stones producing flour with an extraction rate of 100%. For flours with lower extraction rates, sieves may be used to produce wheat flour by removing coarser material (Cornell and Hoveling, 1998). Flours of different extraction rates give different bread types with crumb colours from creamy white to pale brown (Ziegler and Greer, 1971). The loaf volume decreases when bran is added (Pomeranz et al., 1977), but the nutritional value increases.

International marketing classification of common or bread wheat is primarily based on endosperm texture, i.e., the hardness or softness of the grain (Tranquilli et al., 2002). Wheat kernel hardness is largely controlled by one major genetic locus on the short arm of chromosome 5D. The Ha gene comprises puroindoline a, puroindoline b and Gsp-1 genes (Giroux and Morris 1998; Jolly et al., 1993, 1996). Generally, hard wheat is suitable for pan bread and other yeast-leavened foods, whereas, soft wheat is used for cookies, cakes and pastries (Morris and Rose, 1996). Hard kernels in common wheat result from point mutations or loss (null mutation) in one or other puroindoline gene (Morris, 2002). A thorough review of friabilin, puroindolines and grain texture from a molecular genetics viewpoint was provided by Morris (2002) and Chen et al., (2006). Subsequently, several additional novel alleles of Pina-D1 (Pina-D1l, Pina-D1m, Pina-

D1n) and Pinb-D1 (Pinb-D1p, Pinb-D1q, Pinb-D1r, Pinb-D1s, Pinb-D1t) were identified in Chinese and Indian wheat cultivars (Chen et al., 2005).

Different mutations of puroindoline alleles could have diverse effects on milling and processing qualities of endues products. Furthermore, Giroux et al., (2000) reported that progenies carrying the Pina-D1b allele averaged 4.5 units harder than progenies with Pinb-D1b in three hard red spring crosses segregating for Pina-D1b and Pinb-D1b. Martin et al., (2001) showed that the lines with Pinb-D1b in a RIL (recombinant inbred lines) population had significantly softer grain, higher break flour yield, flour yield, milling score, and loaf volume, and lower flour ash content and crumb grain score than the Pina-D1b group.

Nagamine et al., (2003) reported that Pinb-D1b genotypes in a doubled haploid (DH) population had larger flour particle size, higher L* and a* flour colour scores, and higher milling yield and smaller RVA breakdown than the Pinb-D1a soft lines. More recent surveys have found that the Pina-D1b genotype had a significantly higher water absorption and significantly lower milling yield than the Pinb-D1b genotype (Cane et al., 2004), and the Pinb-D1b increased extensibility, dough development time and milling yield in comparison with Pina-D1b (Eagles et al., 2006), indicating that the latter genes could impede the development of hard grained cultivars combining high water absorption and high milling yield. Therefore, grain hardness was associated with numerous milling and bread quality traits even in hard wheats (Slaughter et al., 1992) and these differences were caused by Pina-D1b and Pinb-D1b (Cane et al., 2004).

CHAPTER 3

MATERIALS AND METHOD

3.1 Materials

3.1.1 Raw Materials

Ingredients that are used in making of steamed bread are listed in the Table 3.1. The flour that used is the Hong Kong flour. The Hong Kong flour we used as a control product were obtained from a local supplier (Mee Soya Shop). This flour usually used for the preparation of steamed bread due to the high protein content and gives nice texture to the dough and finished product steamed bread. Also for the dry yeast, baking powder, castor sugar, red been filling and shortening from the Mee Soya Shop. 'Petai' were purchased at Jerteh, which one of the small town of Besut district, Terengganu.

3.1.2 Chemicals

By using analytical method, we used to grade the all the chemicals used in the proximate analysis. Chemicals for proximate analysis includes concentrated sulfuric acid (96- 08%), sodium hydroxide, boric acid, methyl red, green bromocresol, catalyst kjeltabs, petroleum ether, acetone and hydrochloric acid were obtained from Department of Food Science, Faculty of Agrotechnology and Food Scienc

3.2 Methodology

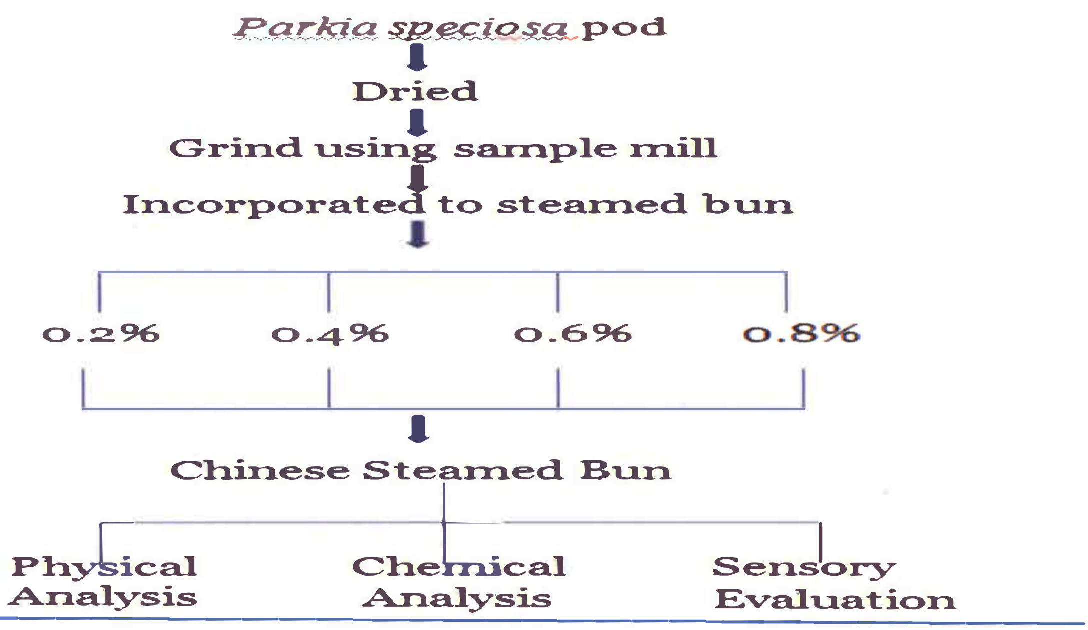

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Figure 3.1 below show the experimental design used in this research

The total of formulation in this research is 5 formulations. The products underwent several analyses including sensory evaluation, physical analysis (texture, color profile and volume) and proximate analysis. In this research, all the formulation were used in the sensory evaluation and physical analysis.

3.2.1 Experimental Design

The table below shows the overall experimental design about the research

Experimental Unit	**Chinese Steamed Bun**
Independent variable	Control, 0.2%, 0.4%, 0.6%, 0.8% of *P. speciosa* pod flour.
Dependent variable	Proximate Analysis, Physicochemical Analysis and Sensory Evaluation.
Treatment level	5
No. of replication	2
No. of experimental unit	5 X 2 = 10
Arrangement	One- Way ANOVA

Table 3.1: Experimental design of *P. speciosa* pod flour steamed bread

The table below shows the experimental unit used in this research

Independent variable	**Chinese steamed Bun**
0%	A
0.2%	B
0.4%	C
0.6%	D
0.8%	E

Table 3.2: Experimental unit for the steamed bun incorporated with PSP flour

The table below shows the sample layout for the research

Batch 1	Batch 2	Batch 3
E = 1	D = 6	A = 11
D = 2	C = 7	D = 12
C = 3	B = 8	E = 13
B = 4	E = 9	B = 14
A = 5	A = 10	C = 15

Table 3.3: Shows the sample layout used for the research

3.3 Methods

3.3.1 Sample Preparation

3.3.1.1 Preparation of Steamed Bread

The preparation of the steamed bread need a lot of time. Where for the first, we mixed all the ingredient like flour, dry yeast, castor sugar and baking powder in the bowl. We mixed all the ingredients by using the bowl mixer. And for the dry mixing we used the hook that suitable for the dry ingredients. Then, after all the ingredients are mixed, change the hook to the dough hook. During this time, the warm water is pour to the mixing ingredients part by part, then put in the shortening. When all the ingredients are mixed and form the dough stop the mixing process and leave the dough to the room temperature to promote the fermentation process in order to double the size of the dough. It is approximately about 30 to 40 minutes for the dough to ferment. After that, forming the dough to mini size of steamed bread to 50 g of each. Before that, the dough is kneaded and pounced to remove the air in the dough and make it soft in texture. The dough must be over ferment to avoid sour smell to the dough. The sour smell is determination to the deterioration of the dough.

The steamed bread is steam in the steamer for 30 minutes. The steaming process is the best method to cook this steam bread because it will retains the food's tenderness, shape, color, and texture as well as using a little or no fat and preserving the vitamins which are usually lost through boiling. The cooked steamed bread is quickly remove from the steamer to avoid over cooking and cooled to room temperature. The flows chart show in Figure3.2.

All the ingredients A are mix in the bowl mixer. The ingredients are Hong Kong flour, s, castor sugar, dry yeast, baking powder, warm water and shortening.

↓

Then the mixture is mix until the dough that has been form is not attached to the bowl and folded together. While at the same time the ingredients B also is prepared and mix together also using the bowl mixer until the dough form folded together.

↓

All the two dough formulation that has been form then proof the dough at the room temperature for about 30 to 40 minutes to make sure the dough become expand 2 times than before.

↓

Then, the dough is knead and pound to make sure the air is remove from the dough and make the Pau more passion and slick in appearance.

↓

The dough is form in the small circles dough with about 48g for each. Then proof again for about 30 minutes.

↓

Finally, all the dough is form in nice form like normal Pau form, then all the Pau is steam in the steamer for about 30 to 40 minutes. Then ready to serve.

Figure 3.2: Steps in producing the Steamed Bread

Table 3.4 shows the basic steamed bun formulation that had been suggested by previous researches

Ingredients	Percentage (%)	Weight (g)
Wheat flour	100	100
Dry yeast	1	1
Water	50	50

Table 3.4: Basic ingredients for steamed bun

Source: Sun et al., (1993)

3.3.1.2 PSP Flour Preparation

This process had been done at Laboratory of Food Technology, Laboratory Of Chemical Analysis and Laboratory of Food Science and Food Service at University Malaysia Terengganu. First the seed of the *P.speciosa* is removed, and the left especially the pod is take and collected. After that, all the pod is washed with distilled water to remove the dirt. Then all the pod is dried in the oven drying for 48 hours at 70^{o} C to achieve 10-12% of moisture content. Next, the dried pod undergoes milling process using the sample mill. The sizes of the flour are set to 0.12mm. Lastly, the *P. speciosa* pod powder was stored in air-tight packaging until further use. The figure 3.3 shows the flow on the procedure of *P. speciosa* pod flour preparation.

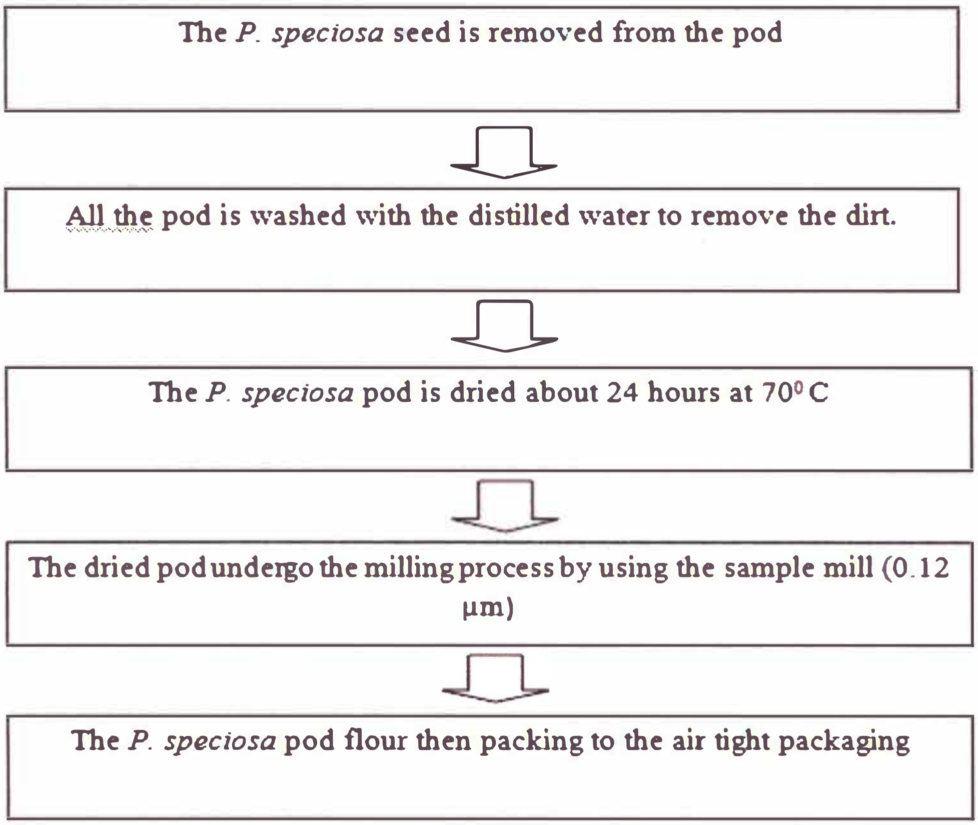


Figure 3.3: Procedure of *Parkia Speciosa Hassk* (petai) flour preparation

(Source: Adapted : Nemesio, Ronald, and Rowena, 1999)

3.3.1.3 Substitution of *P. speciosa* Pod Flour to the Chinese Steamed Bread

The basic approach for the production of *P. speciosa* steamed bread was mix all the ingredients together before undergo the steaming process like the control product one. In the production of the *P. speciosa* steamed bread, the Hong Kong flour percentage is reduce and replace with the *P. speciosa* pod flour where all the *P. speciosa* pod flour is totally produced from the pod of the *P. speciosa* not the seeds. For the processing of the

P. speciosa pod flour, the seed is removed using knife. All the left over is washed and weigh is taken. The *P. speciosa* pod is placed on the tray for the drying process. The *P. speciosa* pod is dried at 70^{o} C for 2 days. Then, all the *P. speciosa* pod that has been dried was undergo the milling process by using the sample mill. The size of flour that setting is 0.12 micron that is small enough for the production of steamed bread.

After that, all the ingredients that is same as the control is prepared. *P. speciosa* steamed bread is produced by incorporating with *P.speciosa* pod flour with the formulation state in the Table 3.2. After the production of *P. speciosa* is done, the flour is added to the mixture as an ingredient. Wheat flour was substituted with *P. speciosa* pod flour according to percentage (0 %, 0.2%, 0.4%, 0.6% and 0.8%). The basic formula of the Chinese steamed bread is as stated in table 3.4. Modification was done by substitution of *P. speciosa* pod flour according to the percentages. Table 3.5 shows the Chinese steamed bread formulation that were used in this study.

Ingredients	Control A	B	C	D	E
Hong Kong Flour (g)	100	99.8	99.6	99.4	99.2
P. Seciosa Pod Flour (g)	0.0	0.2	0.4	0.6	0.8
Water (g)	65.0	65.0	65.0	65.0	65.0
Castor Sugar (g)	11.0	11.0	11.0	11.0	11.0
Shortening (g)	8.5	8.5	8.5	8.5	8.5
Dry yeast (g)	1.0	1.0	1.0	1.0	1.0
Baking Powder (g)	0.5	0.5	0.5	0.5	0.5

Table 3.5: Chinese steamed bun formulation

Source: Adapted from Sun et al., (2009), Huang et al., (1993

3.3.2 Chemical Analysis

3.3.2.1 Proximate Analysis

Proximate analysis is that was carried out on *P. speciosa* steamed bread include the determination of moisture, crude fate, crude protein, ash and carbohydrate content. All the analysis is performed according to AOAC (2000) method.

3.3.2.2 Moisture Content

Porcelain crucible was used in determining the moisture content. All the crucibles were dried in oven for 30 minutes prior to sample loading. After drying, the crucibles were cooled in desiccators to avoid moisture absorption from surrounding. The *P. speciosa* steamed bread was ground first instead of using in bun shaped in order to make sure uniformity heat penetration. Then, the cold dry crucibles were initially weighed and 5 g of sample was placed in the crucibles. After that, the crucible with sample was dry in oven at 105° C for 24 hours. After dried, the crucibles with sample was cooled in a desirable and re-weighed percentage of dried matter and moisture content in the product were calculated using Equation 3.1 and 3.2

$$\% \text{ Of dried matter } = \frac{\text{weight of dried matter}}{\text{Weight of sample}} \times 100 \qquad \text{Equation 3.1}$$

$$\% \text{ Of Moisture} = 100 - \% \text{ of dried matter} \qquad \text{Equation 3.2}$$

3.3.2.3 Crude Fats Content

In the determination of crude fat content, the ground sample was dried for 2 hours at 105° C. In this analysis, Soxhlet method was applied. Firstly, the extraction cups were dried in an oven and cooled in desiccators. Then, about 2.0g of dried sample (W_1) was weighed in the extraction thimble. By using thimble handler, the extraction thimble was placed into the extraction unit (Soxtec Avanti 2055, FOSS, Sweden, 2002). After that, the dry extraction cups which were kept cold in desiccators (W_2) were weighed and 70 ml of petroleum ether was poured into each extraction cups. This procedure was done in fume hood as a precaution. Then, the extraction cups were attached to the extraction unit and the process was RUN. When the extraction process was completed, extraction cups were took out and dry in an oven at temperature 105° C for 2 hours. At the end of the procedure, the cups were cooled in desiccators and then re-weighed (W_3). The percentage of crude fat was calculated according to Equation 3.3

$$\% \text{ Crude Fats} = \frac{W_3 - W_2}{W_1} \times 100 \qquad \text{Equation 3.3}$$

W_1 = weight of sample (g)

W_2 = weight of extraction cups

W_3 = weight of extraction cup with fats

3.3.2.4 Protein Content

Protein content was determined by the concentration of ammonium presence in the solution. In this analysis, Kjedahl method was used following AOAC, (2002). The *P. speciosa* steamed bread was grind or cut it into the smaller from prior to analysis. About 1.0g of *P. speciosa* steamed bread was weighed in digestion tube and 2 tablets of Kjeltabs catalyst Cu 3.5 were added. Then 12ml of concentrated H_2SO_4 was poured carefully into the tube and slowly shake to wet the sample. After that, the tubes were connected to the digester (2006 Digester, FOSS, Sweden, 1998). After approximately 5 minutes, when the acid vapors appear only at the top of exhaust system, the system was stopped. The digestion process was continued until green or light blue solution was formed and then cooled it vertically for 10 to 20 minutes. After that, 75ml distilled water was carefully poured in the cold tube and continued with distillation process. For preparing the receiving solution, 25ml of 4% Boric acid and 10 drops of Green Bromocresol indicator were added into conical flask 250 ml. Then, the receiving solution was placed to the distillation unit (2100 Kjeltec Distillation Unit, FOSS, Sweden, 2002).

Automatically flow the 50 ml of 40% NaOH into the tube and the distillation process was operated for 11 minutes until light green solution was formed. The product from distillation process then titrated with 1.0 N of standard HCL until the color turned to blue or grey and the titration volume was recorded. For protein analysis, a blank solution was also used as apart of the analysis. Blank only contains 12 ml concentrated H_2SO_4 and 2 tablets of Kjetabs catalyst Cu 3.5 without sample. Blank was also undergone the same procedure as for samples. The percentage of nitrogen and protein in sample was calculated according to Equation 3.4 and Equation 3.5.

$$\%\ \text{Nitrogen} = \frac{(T - B) \times N \times 14.007 \times 100}{\text{Average of sample in mg}} \qquad \text{Equation 3.4}$$

$$\%\ \text{of Protein} = \%\ \text{Nitrogen} \times 6.25 \qquad \text{Equation 3.5}$$

T = Titration volume of sample

B = Titration volume for blank

N = Normality of HCL

3.3.2.5 Ash content

For determination of ash content, ground sample was weighed about 5.0g. The dry crucible was weighed prior to sample loading. After that, the sample was placed into the furnace (Ashing Muffle Furnace, CARBOUTE, UK), with temperature 550^o C. the ashing process was operated for one day. On the next day, the sample was taken from the furnace and cooled in desiccators. Then, the final weight of the crucible with sample was measured. Percentage of ash in the sample was calculated according to Equation 3.6

$$\% \text{ Ash} = \frac{\text{weight of ash}}{\text{Initial weight of sample}} \times 100 \qquad \text{Equation 3.6}$$

3.3.2.6 Crude fiber Content

Crude fiber content of CSB was determined by using Fibertec 2021 system with fibercap capsule according to AOAC (2000) method. First, fibercap capsule was dried in the oven for 1 hour at 60^0 C. Then the capsule was closed with the lid and places it into the capsule holder. The extraction process was done by treatment of 350ml of sulfuric acid solution. First, the sulfuric acid solution was placed on the hot plate to heat it until boiling. When the reagent is boiling, the heating point was lowered to level 5. Then, the capsule was added slowly with 'carousel'. It was added fully into the reagent until the sample sink by shaking it slowly. Next, 'carousel' was added fully into the reagent. Follow on, condenser was placed above the condenser extraction cylinder and tap water was opened for reflux system. The solution was heated slowly for around 20 minutes. After the process was done, the extraction cylinder, carousel and capsule were washed with the boiled 350ml of distilled water for 3 times. Next, capsule was repeated by using Sodium Hydroxide solution 1.25% follow by 3 times of distilled water again. Then, the capsule was removed from the 'carousel' and dried in the oven at 130^0 C for 2 hours and calculate the fiber content.

$$\% \text{ crude fiber } = \frac{(W3-W1)-(W5-W4)}{W2} \times 100 \qquad \text{Equation 3.7}$$

W1 = weight of capsule

W2 = weight of initial sample

W3 = weight of capsule + residue

W4 = weight of crucible

W5 = weight of crucible + ash

3.3.2.7 Carbohydrate Content

Total carbohydrate was calculated as Equation 3.8 :

% carbohydrate = 100 – (% moisture + % crude fats + % crude protein + % ash)

Equation 3.8

3.3.3 Physical analysis

The *P. speciosa* steamed bread is stored at 5° C was used for physical analysis within 48 hours. Physical analysis was performed immediately after produced in order to avoid error, while texture analysis was done on the next day of production.

3.3.3.1 Color analysis of Steamed Bread that incorporated with PSP flour.

Color analysis was done using Minolta Chromameter. The equipment was calibrated with the while standard calibration plate as provided by the manufacturer. *P. speciosa* steamed bread was placed in transparent plastic. The tip of measuring head was pointed on the sample and the value of L* (lightness) a* (redness) and b* (yellowness) were recorded at 5 different surface of area of *P. speciosa* steamed bread.

3.3.3.2 Texture Analysis Of Steamed Bread

Texture analysis (TA. XT plus Stable Micro) was used to measure the firmness and hardness of *P. speciosa* steamed bread. The probe that was used Knife Edge with Slotted Insert (HDP/ BS) using 25 kg load cell. The size of *P. speciosa* steamed bread was standardize into 4cm X 4cm X 0.3cm dimension in order to fit on the platform. The sample was then placed at the center of platform. The sample was then placed at the center of platform and continues with measurements with the test speed 2.0 mm/s and distance 10 mm.

3.3.3.3 Table Top Microstructure

TM-1000 images show sample surface morphology in contrast due to different average atomic number composition within the sample

3.3.4 Sensory Evaluation

Sensory evaluation was carried out for all formulation of the *P. speciosa* steamed bread. Acceptance test was used with 9-point hedonic scale ranging from 1- dislike extremely to 9- like extremely. Attributes that were evaluated includes color, order, hardness, chewiness, elasticity, other taste and overall acceptance. The consumer panelists were chosen among UMT students (30 panels). The size of *P.speciosa* steamed bread was standardize into 50g for each and 12g for the filling. The sample was then packed in transparent plastic packaging and coded with 3-digit codes before it was permuted. The permuted samples were served to the panels in a tray.

3.4 Data Analysis

All the analyses were done in duplicate with three reading for each replication. The design of experiment used was completely randomized design (CRD). All the data collected were analyzed using one-way analysis of variance (ANOVA), and the significant difference (P< 0.05) data were further analyzed using Fisher's Test. The data analyses were performed using Minitab14 software and all the data obtained were presented as mean ± standard deviation.

CHAPTER 4

Results And Discussion

4.1 Proximate Analysis

Table below showed the chemical composition of the flour

Composition	PSP flour (%)	Hong Kong flour (%)
Moisture content	9.96b ± 1.047	11.68a ± 2.501
Protein	11.58a ± 3.005	11.08a ± 0.057
Fat	0.31b ± 0.106	0.51a ± 0.028
Ash	0.03a ± 0.007	0.06a ± 0.007
Crude Fiber	15.33b ± 0.857	1.58a ± 0.394

Table 4.1: Chemical composition of PSP flour and Hong Kong flour

Note: Mean with different superscript alphabets have significant difference ($p<0.05$).

Mean is gathered from 5 different responses ($n=5$)

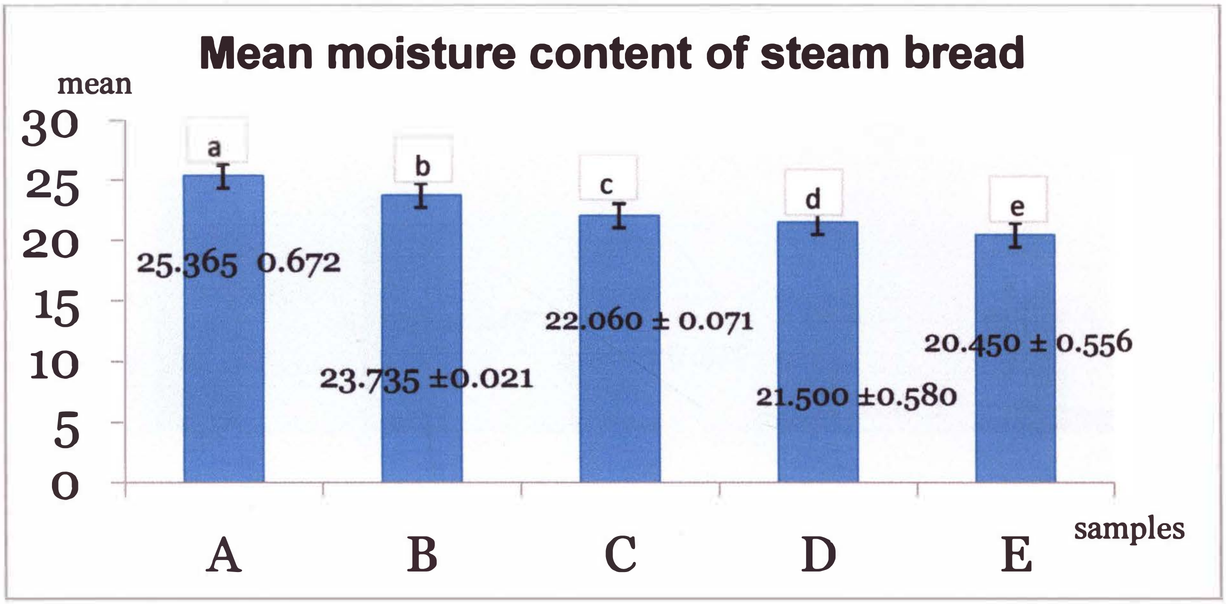
Proximate analysis was conducted in order to determine the chemical composition for the nutritional value of the *P. speciosa* pod flour and the Chinese Steamed Bread (CSB) that was incorporated with the PSP flour.

For this analysis, flour also undergo proximate analysis. Results shows that PSP flour consisted lower moisture content of 9.96% where as Hong Kong flour (HF) consisted slightly higher moisture content 11.675% (Table 4.1). It also could be observed that high in protein content 11.575% for PSP flour and 11.08% in the HF.

But the one bigger difference for the fiber where very high amount of fibre was found in the PSP flour (15.33%) where only (1.58 %) in the HF flour. It could be observed that the both flour have low amount of fat with 0.51% in HF and 0.3%1 in PSP flour. Thus, have connection with the previous study. The suggestion that PSP flour could be used to replaced wheat flour for bakery or pastry products. Starches from PSP could act as texture supporting component during the baking process whereas the fibre could promote gastro health for the consumer since health food trend in bakery such as whole grain breads or cookies are on the rise.

4.1.1 Moisture Content

Graph 4.0: Mean of moisture content of CSB

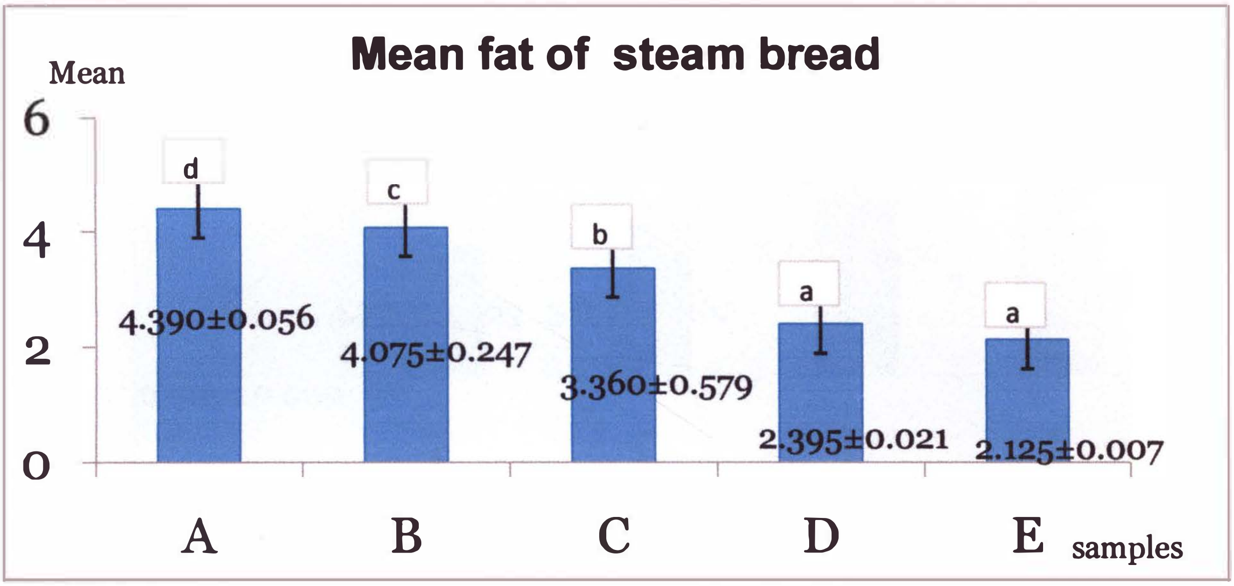


A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

Results showed that the Chinese steam bread (CSB) that in-corporate with the PSP flour tend to have lower amount of moisture content when higher amount flour is added to the formulation. The amount of moisture that we could observed is (25.365±0.672) % for sample A and (23.735±0.021) % for sample B. Sample A is a control while sample B has been added with 0.2% of PSP flour. Result showed that sample B contains higher amount of fiber. Fiber in the PSP flour is highly absorbed the water in the bread make the bread have the lower moisture content. The larger the proportion of damage starches the higher water absorption of the flour (Stauffer, 1998). The properties of the dough will vary according to the level of added water. When there is too little water have been added, the dough will be firm and difficult to mould (Cauvin and Young, 2001), thus producing breads that have small volume and poor external appearance.

4.1.2 Crude fat analysis

Graph 4.1: Mean of fat content of CSB

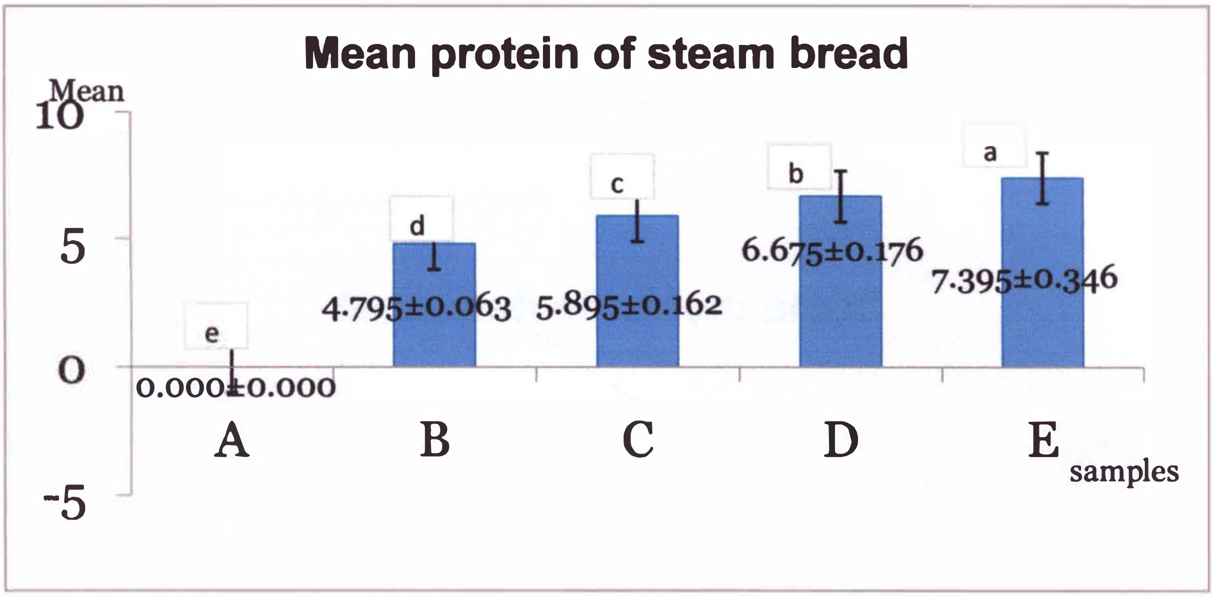


A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

There are significant difference when $P<0.05$ for the fat content. From the results we can examine that the amount of the fat content of the bread decreased. This is reflected on the results for sample A(4.390±0.0566) %,B(4.075±0.275) %, C(3.360±0.5798) %, D(2.395± 0.0212) % and E (2.125±0.071) %. The amount of the fat reduced due to the percentage of the fat content in the PSP flour is lower than HF flour, that is (0.31± 0.106) % for the PSP flour and (0.51± 0.028) for HF flour. Lipid plays an important role in maintaining a stable gas cell structure via its interaction with the protein at the gas/liquid interface. However, the fiber content obtained in the bread when incorporated with PSP flour tends to absorb the oil from the bread and the amount of the fat supposed to be increase but the percentage of the fat in the PSP flour lower compared to the HF flour make the percentage of fat content decreased (Graph 1.1).

4.1.3 Protein analysis

Graph 4.2: Mean of protein content of CSB

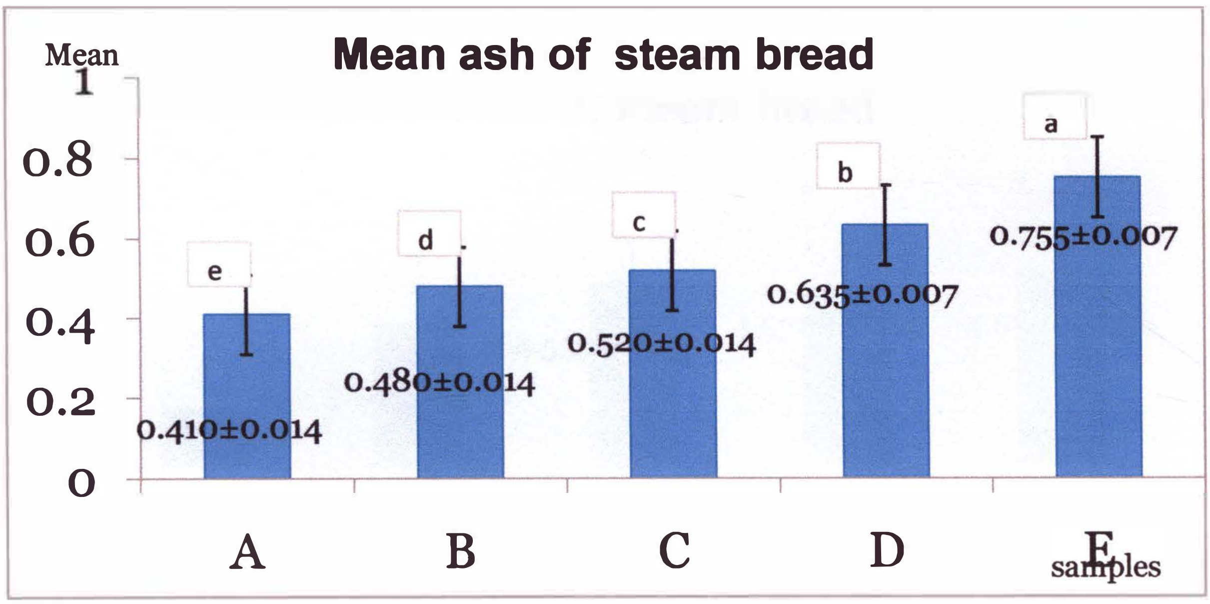


A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

The amount of protein is increases as the PSP flour also increased. For the sample B (4.795±0.0636) % and for sample C (5.895±0.1026) % where (6.675± 0.176) % for sample D and (7.395± 0.346) % for sample E. This is showed that more amount of protein increased when more flour is added to the formulation. This is good for the bread because protein is important in bread making. Previous researches have been suggested that, there are no correlation between steamed bread quality and flour quality (Zhang and Wang, 1987). But there are other researchers had been suggested that there are significant and positive correlation between protein content and volume of steamed bun (Addo et al., 1991). On the other hand, Lukow et al., (1990) also suggested that steamed bread quality is positively correlated with protein content and gluten strength of wheat flour used. While, according to the Huang et al., (1996), steamed bread quality is independent on flour protein content as flour protein content increase beyond 10%. The contrasting reports may be due to the use of different types of flour, laboratory processing and evaluation procedures.

4.1.3 Ash content analysis

Graph 4.3: Mean of Ash content of CSB

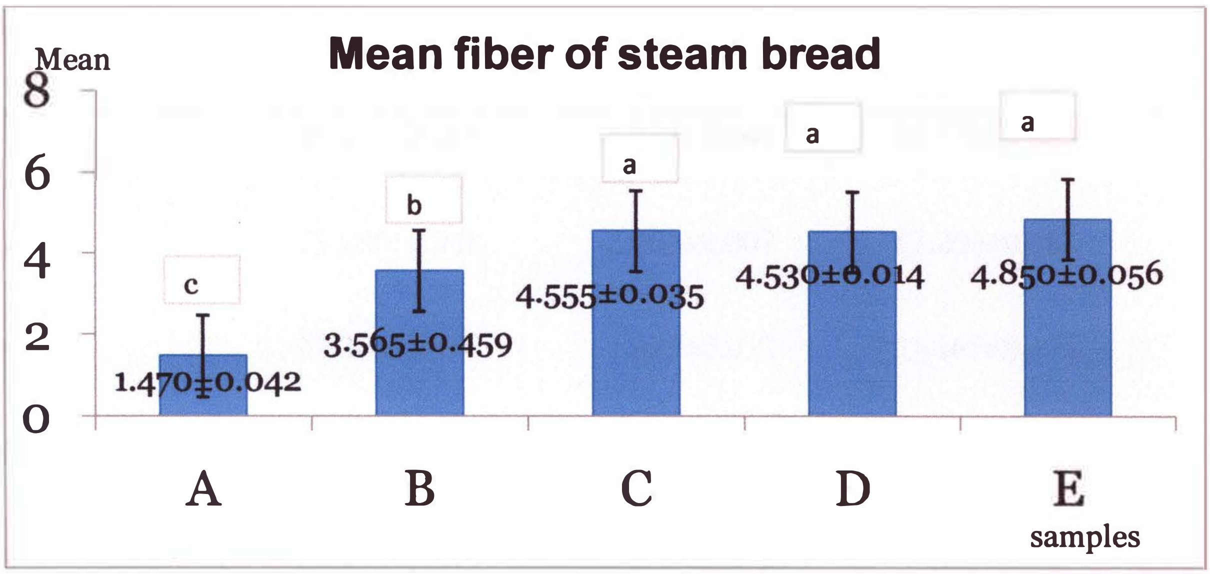


A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

The reading for ash and fiber also increase continuously when the amount of flour is increases in the formulation. There are different amount of ash between control and the others samples that incorporated with the PSP flour. Sample A (0.410±0.0144) % while sample E (0.755±0.0070) %. The ash is the important parameter. The lower the ash content, the higher quality of flour and steam bread. Where there present of the ash will decreases loaf volume of steam bread. According to Ozboy and Koskel (1997) and Kock et al., (1999) a reduction in bran size decreases loaf volume. Thus high in pericarp and ash contents affects flour quality and a smaller pericarp size has a negative impact on steam bread height.

4.1.4 Crude fiber Analysis

Graph4.4: Mean of fiber content of CSB



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

For the fiber, sample A (1.47±0.0042) % and sample E (4.85± 0.0566) %. Sample E that was incorporated with PSP flour tend to have higher percentage of fiber as compared to the control. This is proved that the PSP flour relatively high in fiber content. The hardness of the steam bread increase with the addition of the PSP flour.

When fiber are present, it will absorbed the water in the steam bread then lowered the moisture content of the steam bread also increases the hardness of the steam bread. Hence, decrease the loaf volume of the steam bread.

4.2 Colour characteristics

samples	L*	a*	b*
A	80.385±1.266	-2.325±0.007	18.710±0.269
B	78.280±0.948	-2.005±0.007	17.260±0.283
C	72.385±0.460	-1.025±0.077	21.165±0.375
D	68.725±0.601	-0.180±0.155	23.600±0.283
E	66.615±0.573	0.295±0.049	19.960±0.127

Table 4.2 Color parameters (L*, a* and b*) of CSB

Note: Mean with different superscript alphabets have significant difference ($p<0.05$).Mean is gathered from 5 different responses ($n=5$).

Flour	L*	a*	b*
HF	80.635±1.605	-2.380±0.099	18.325±0.034
PSP	72.280±0.438	1.190±0.155	19.800±0.424

Table 4.3 Color parameters (L*, a* and b*) of HF and PSP flour

Note: Mean with different superscript alphabets have significant difference ($p<0.05$). Mean is gathered from 5 different responses (n=5)

Colour measurements (L*, a* and b* values) on the CSB and the flour was carried out after I hour steaming the bread, which approximately the bread temperature turned to the room temperature. This colour analysis was carried out using a Minolta CR 310 colour meter. Two measurements were made on the same piece of the bread and for the flour. Then the average is calculated using software Minitab. Results showed that there are significant difference when we analyze data with the ($P<0.05$). The results refer to the Table 4.3. From the result could be observed that the bread that was incorporated with the PSP flour gives reduce in the amount of L* value. So, from this result state that the bread that do not incorporate with the PSP flour was bright in colour since have 80.385±1.266 for the L* value compared to the bread that was added by the PSP flour have

78.280±0.948 for sample B, 72.385±0.460 for sample C, 68.725±0.601 for sample D and 66.615±0.573 for sample E.

On the other hand, the a* value for the bread sample is increased respectively from -2.325±0.007 for sample A and -2.005±0.007 for sample B, -1.025±0.077 for sample C, -0.180±0.155 for sample D and 0.295±0.049 for sample E. This is showed that the colour of the bread is slightly reddish (brownish) when there is increased amount of the PSP flour that was incorporated in the bread. Whereas significantly positive value for the sample E.

This colour formation might be due to the presence of the polyphenols or antioxidant during the processing. Whereas, the greenish colour of bread for sample A, B, C, D and E are shown in b*(18.710±0.269, 17.260±0.283, 21.165±0.375, 23.600±0.283 and 19.960±0.127, respectively) indicates that the presence of chlorophyill. This is showed that with the incorporation 0.2% to the 0.8% of the PSP flour to the formula of the steamed bread have significant differences between the sample in terms of colour.

Next, the results that observed from the colour of the Hong Kong flour and the PSP flour. There was significant difference between the two flours. The HF flour shows that relatively high in L* values where 80.635±1.605 which is the flour was bright in colour compared to the PSP flour 72.280±0.438 (Table 4.4). On the other hand, a* value of 1.190±0.155 of PSP flour indicates a slight reddish (or Brownish) colour in the powder whereas significantly ($p<0.05$) a lower value -2.380±0.099 in the HF flour. Whereas, the greenish colour of PSP flour and HF flour powders showed in b* (18.325±0.034 and 19.800±0.424, respectively indicates the presence of chlorophyll. These PSP powders could be considered as antioxidant fiber. Similar extracts form cabbage outer and grapes have also been reported(Nikara, 2009).

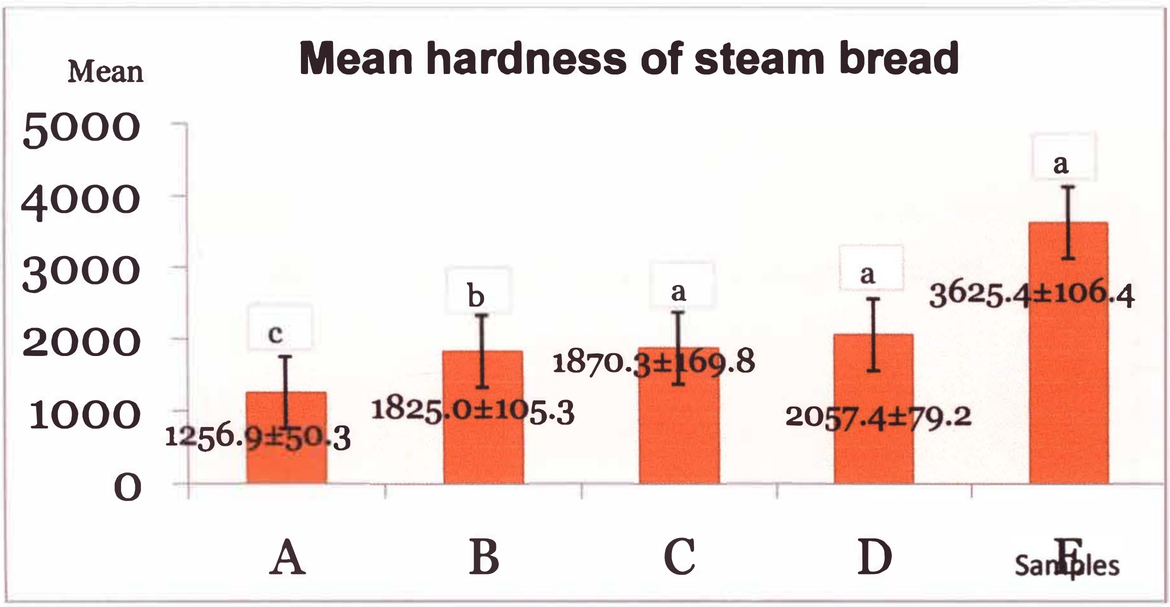
4.3 Variation in texture of CSB when incorporation with PSP flour

For the 5 samples tested, there was a significant difference affect at level ($p<0.05$). For the hardness the score of mean showed decreased by adding the PSP flour. It means that when added the PSP flour make the bread become harder. This is maybe due to the higher amount of the fiber content in the flour. When the flour is incorporated with the steamed bread the moisture content of the flour bread also lowered. This is contributed to the increased of hardness texture when the bread analyze with the texture analyzer.

Actually all the results showed that for the all attributes of texture showed that lowered in springiness, chewiness and resilence when the PSP pod is added. This is may be due to the low of the fat content of the flour. The PSP flour have very low of fat content. The fat amount impacts differently on the internal texture of CSB. Only a few parameters showed significant difference between the CSB that incorporated with PSP and the control, including hardness, springiness, chewiness and resilence. Because of low fat content will cause the reduced the volume and the softness of the steamed- bread.

The mechanism of the contribution of lipid to wheat product quality especially bread-baking quality has been discussed(Carcea & Schofield, 1996). Two properties are required for good performance of bread bough; optimum rheological properties and a stable gas cell structure. It is believed that lipids play an important role in maintaining a stable gas cell structure via its interaction with protein at the gas or liquid interface of liquid lamellae surrounding gas cell in the bread.

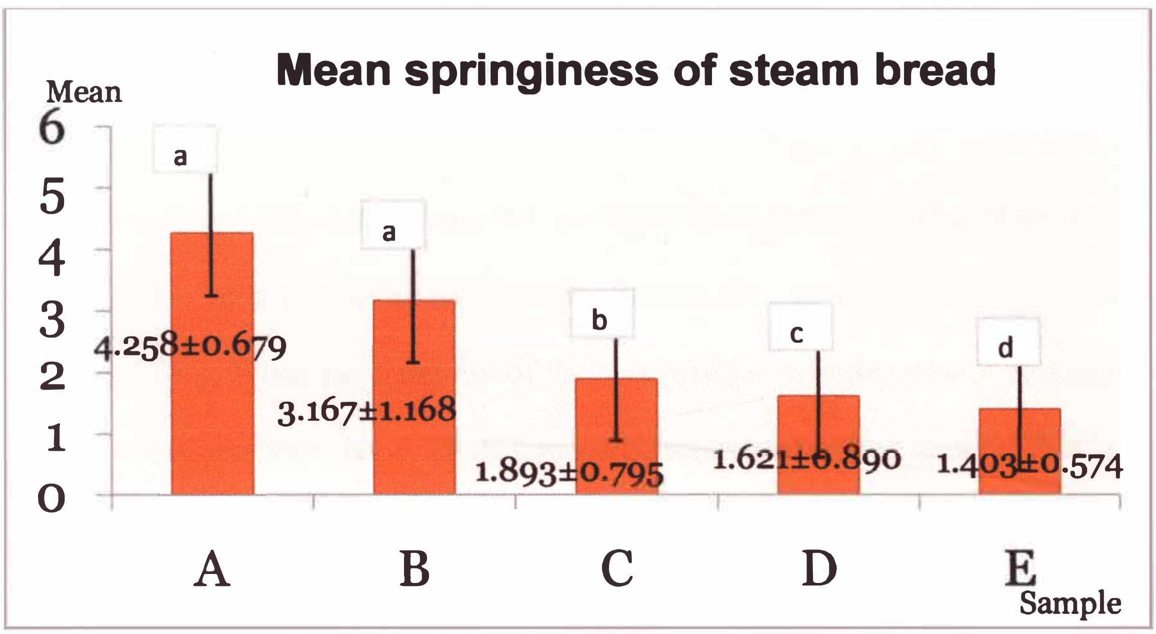
Graph 4.5: Mean Hardness of steam bread



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

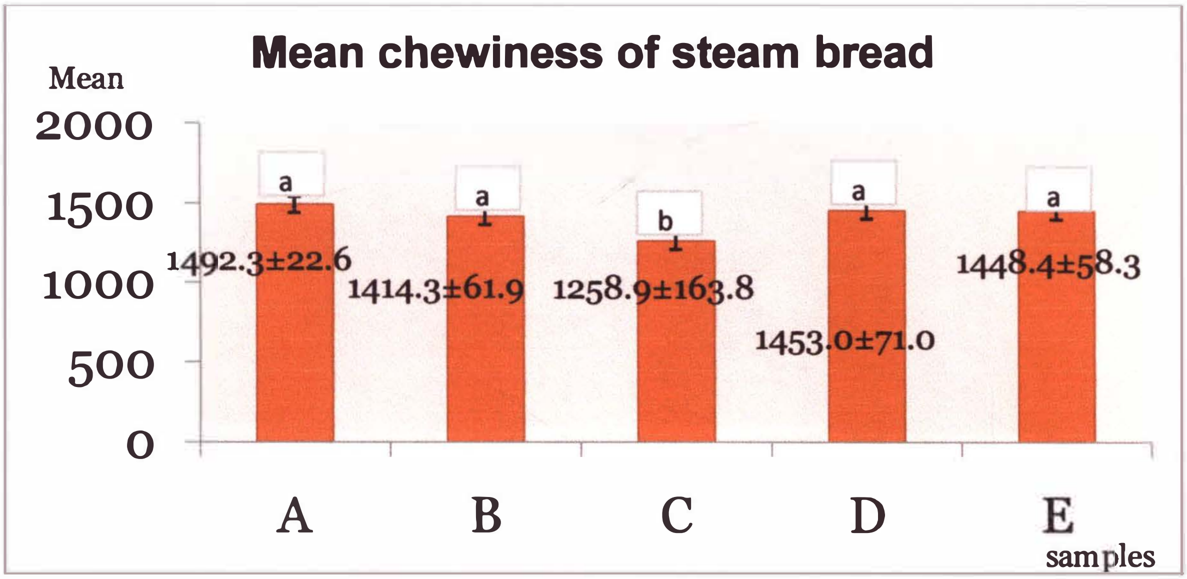
For the 5 samples tested, there was a significant difference affect when ($p<0.05$). For the hardness the score of mean showed decreased by adding the PSP flour. Sample A and E showed big differences. A (1256.9±50.3) while E (3625.4±106.4) . This is shows that hardness of the steam bread increase when PSP flour present. This is due to the fiber and ash content. Fiber will absorb the water in the dough make the dough hard and also contribute the increasing hardness of the bun. The ash content will affect the flour quality where the high amount of ash will decrease the loaf volume of bread also the height of the steam bread. Knorr and Betschart, (1978) suggest that added foreign protein will have the weakening effect on the wheat flour dough due to the dilutions of gluten structure. This will be result in lower volume and has negative effects on the other quality attributes such as tenderness. Indeed, the ability of the wheat flour to form visco-elastic dough with gas-holding properties is primarily due to the gluten proteins. When heating, starch gelatinization occurs where the structural orders of starch granules are irreversibly destroyed.

Graph 4.6: Mean of springiness



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

Graph 4.7: Mean chewiness of steam bread



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

Results showed for the springiness attributes of texture are is in graph 4.7. There are big difference between control and sample. Results showed A (4.2585±0.6795) while E (1.4035±0.5749). When the hardness of the bun increase will decrease it springginess. But, for the chewiness there is no big difference between control and sample. This is may be due to the low fat content of the flour. The PSP flour have very low fat content. Because of low fat content will cause the reduction in the volume and the softness of the steamed- bread. It is believed that lipids play an important role in maintaining a stable gas cell structure via its interaction with protein at the gas or liquid interface of liquid lamellae surrounding gas cell in the steam bread (Carcea & Schofield, 1996).

4.4 Table Top Microstructure of CSB

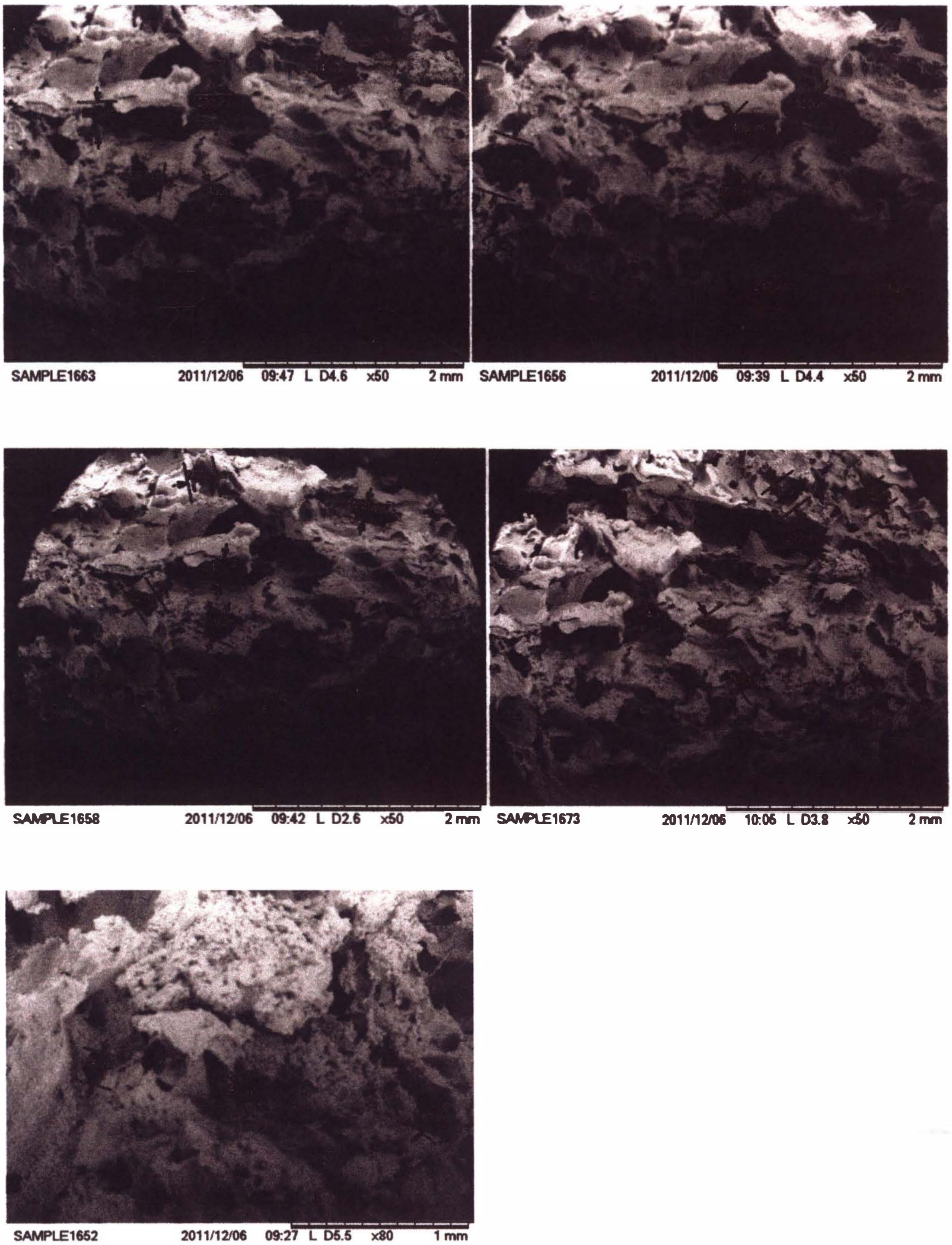


Figure 4.1 : Morphology of the steam bread when incorporated with PSP flour at magnification X 50 using Table Top Microstructure

Result, shows that the pore of the bread reduced when the flour added to the formula. The pore for sample A between 370µm to 580µm which is bigger compared to sample E 143µm to 167µm means that, higher amount of fiber detected in the bun the size of pore become smaller. Fiber content is too heavy make the bun hard to expand during the steam processing. It is also because of the absorption of lipid by the fiber. Pomeranz, Huang and Rubenthaler (1991) stated that lipid play an important role in maintaining a stable gas structure via its interaction with protein at the gas/ liquid interface, to make the volume expand during the steaming process.

4.5 Sensory evaluation for CSB

The top and bottoms of steamed bread were moved to produce 40mm thick middle slices, which were subdivided into 20mm-thick pieces. Both top and bottom pieces were cut into eight rectangular portions. Each panelist always received the portions from either top or bottom slices. The following techniques were used in the sensory evaluation of textural properties: crumb firmness- assessed by gently compressing the sample between thumb and index fingers. Crumb stickiness- assessed by placing the sample between the molar teeth and biting down twice, slowly, noting the force required to pull the teeth apart after each bite.

Elasticity (springiness)– determined by placing the sample between thumb and index finger, fully compressing the sample and then releasing the pressure. The degree of recovery was evaluated after 10s. A very elastic sample will recover completely, whereas an inelastic sample will remain compressed. If cracks occur in the crumb after compressing, elasticity should be reduced according to the extent of the break. Cohesiveness - assessed by chewing the entire sample the molar teeth six times and evaluating the degree to which the chewed sample held together in a mass, while being moved in the mouth by the tongue.

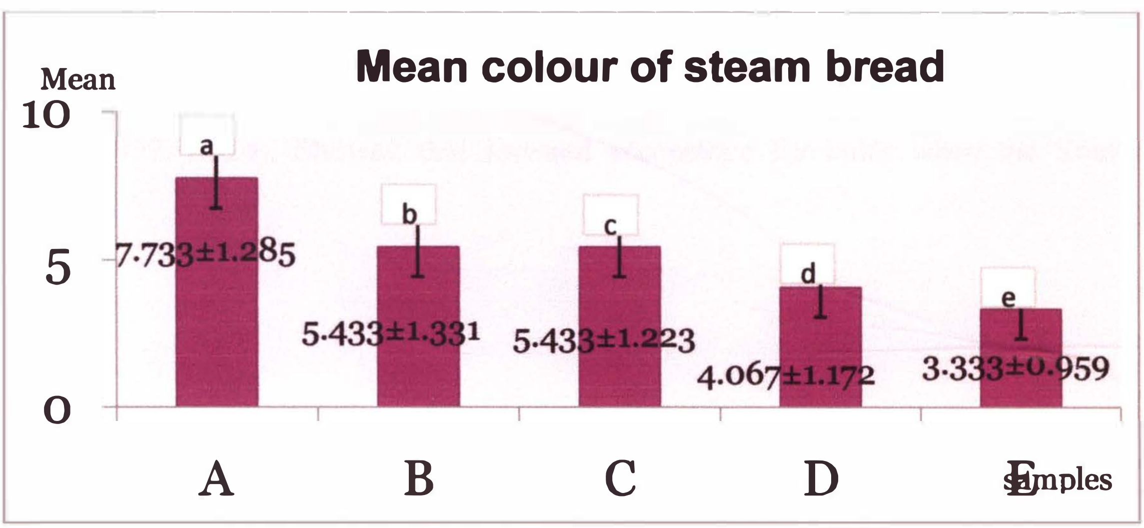
The selected external quality parameters were: skin colour, crumb colour, shininess of the skin and smoothness of the skin. Colour intensity was defined as the strength of the colour from dark to light. Shininess is the amount of light reflected from the steamed bread surface. Smoothness is the absence of dimples, blisters or areas of gross gelatinisation. The results of sensory evaluation of textural properties of northern-style steamed bread from the initial experiment are presented in graph 4.10 for hardness attribute. The results of sensory tests from the verification experiment followed similar trends. The softness of steamed bread crumb was highly correlated with cohesiveness ($P<0.05$), which may indicate that these two quality parameters were controlled by the same flour quality factor. Statistical analysis of the relationship between sensory assessment and measurement of textural properties is showed in the graph 4.11 and graph 4.12 for chewiness and elasticity.

The results from the verification experiment were comparable with those from the initial experiment. The results showed that the steam bread have low of eating quality when there is more amount of the PSP flour added to the formulation. The results could be observed from the graph 4.7 to graph 4.13. This sensory evaluation using 30 panels was found to be correlated significantly with the product of colour, odor, hardness, chewiness, elasticity and the overall acceptance. Northern-style Chinese steamed bread with good eating quality should be elastic, cohesive and non-sticky when eaten.

Overall panel preferred eating quality is balanced among the following textural characteristics: softness, elasticity, non stickiness and cohesiveness. By calculating the product of these four textural characteristics rather than their sum, a greater emphasis can be placed on the requirement for balance among these parameters. For example, in the case of steamed bread made from weather damaged wheat flour or flour with high alpha-amylase activity, two of the four attributes scored poorly (elasticity and non-stickiness) and two scored well (softness and cohesiveness).

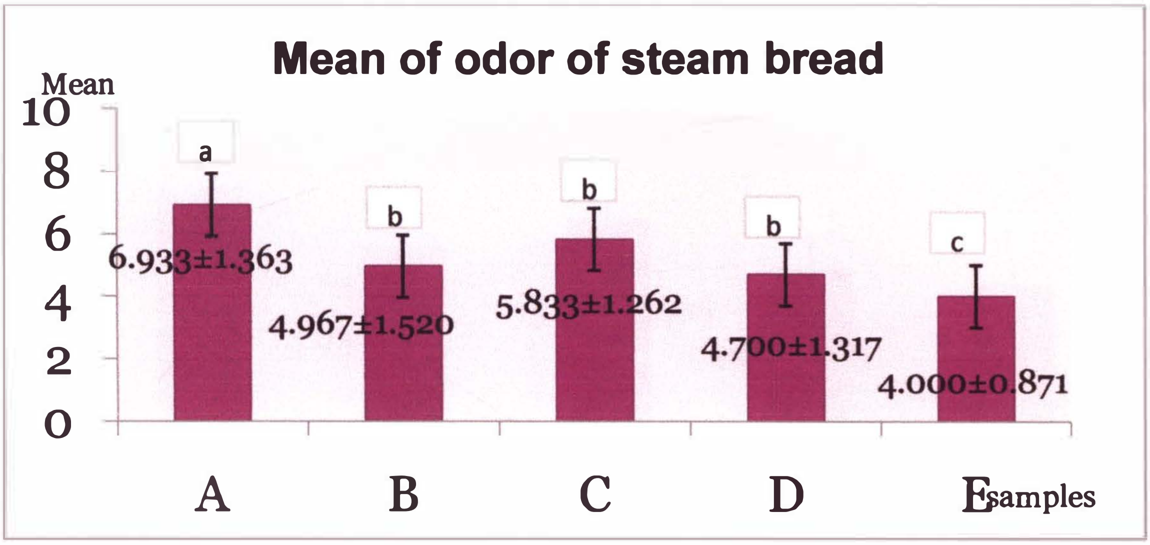
An addition of the four parameters would rate the steamed bread to be of average (medium) quality. Multiplication of the four parameters on the other hand, resulted in a low score, which is a more accurate indication of the overall poor eating quality. The objective of measurements of the sensory evaluation when the steamed bread was showed the results was significantly at ($p<0.05$).

Graph 4.8: Mean of colour of Chinese Steam Bread (CSB)



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

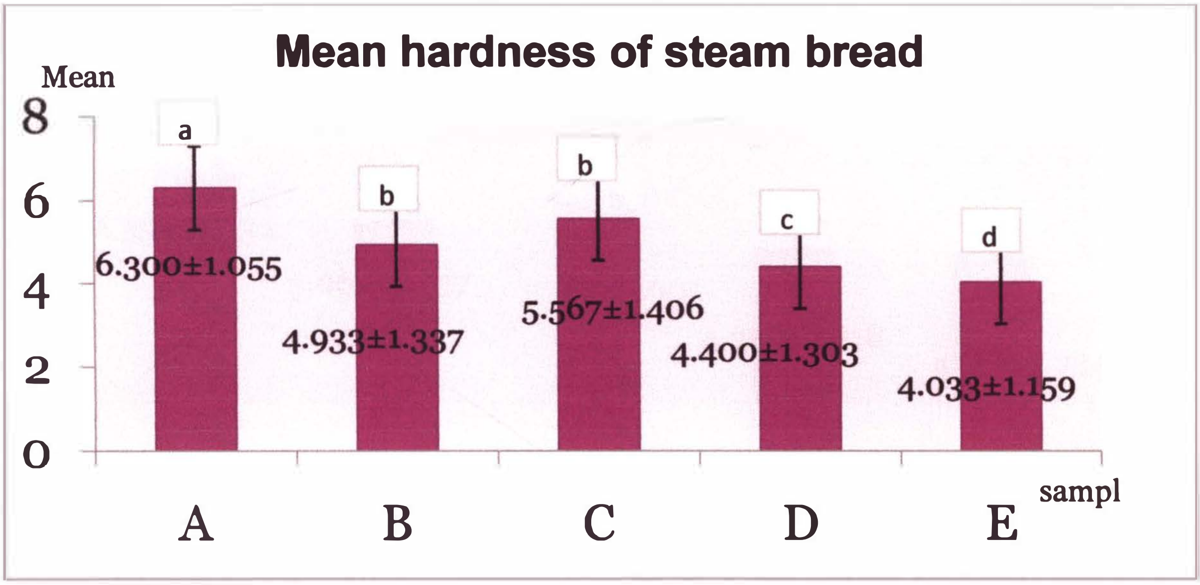
Graph 4.9: Mean of odor Chinese Steam Bread (CSB)



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

For the color acceptance is decreased with the amount flour added to the bread. The results showed A (7.733± 1.285) while for the sample E (3.333±0.959). This is because of the presence of the polyphenols or antioxidant during the processing make the bread is slightly brownish. But there is same results for sample B and C (5.433±1.331). Means that there is no differences between the sample. Results for the odor A (6.933± 1.363) while B (4.957±1.520). Showed that lowered acceptance for color when the flour is added.

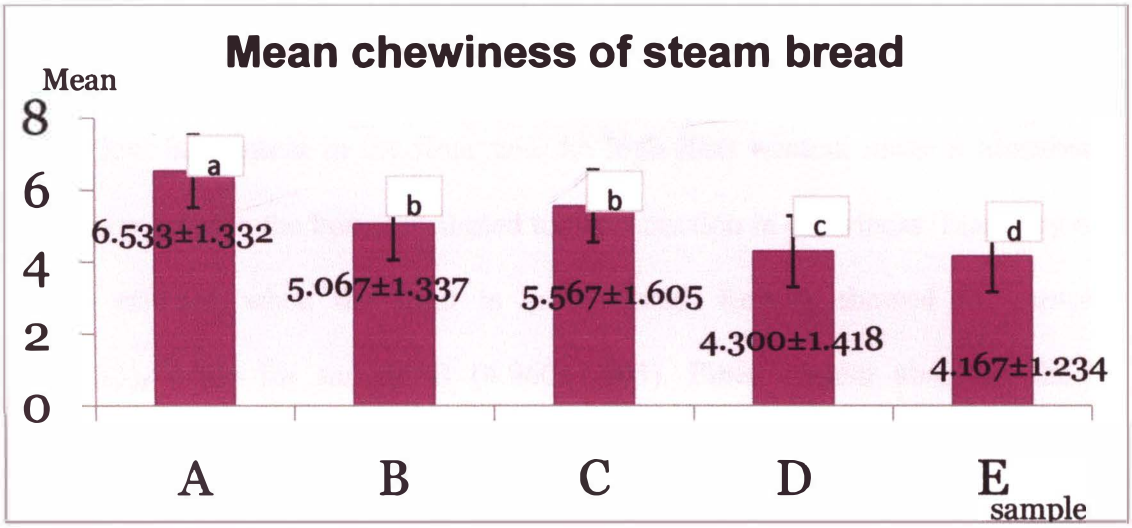
Graph 4.10: Mean hardness of steam bread.



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

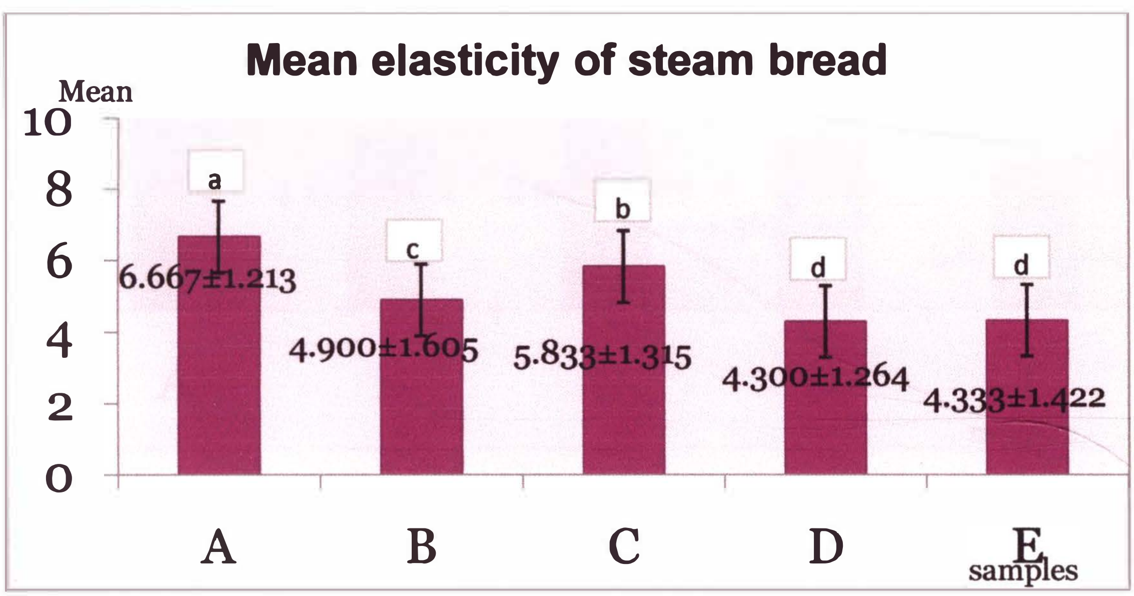
Resuls on hardness shows significant difference in some of the formulations. Results showed A(6.300±1.0055) and sample B showed (4.933±1.337). For C (5.567±1.406) and D (4.400±1.303) which is low that sample C. Low acceptance for the bread that incorporated with the PSP flour for sample E that is (4.033±1.159). This is due to the fiber content that absorbed the of water make the steam bread need more water to make a binding of dough. This is contributes to the increases of hardness and reduce the volume of steam bread. The fiber also will weaker the strengthening of the gluten formation make the dough easily to cut off and affect the expanding of the steam bread during the steaming processing.

Graph 4.11: Mean Chewiness of Chinese Steam Bread (CSB)



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

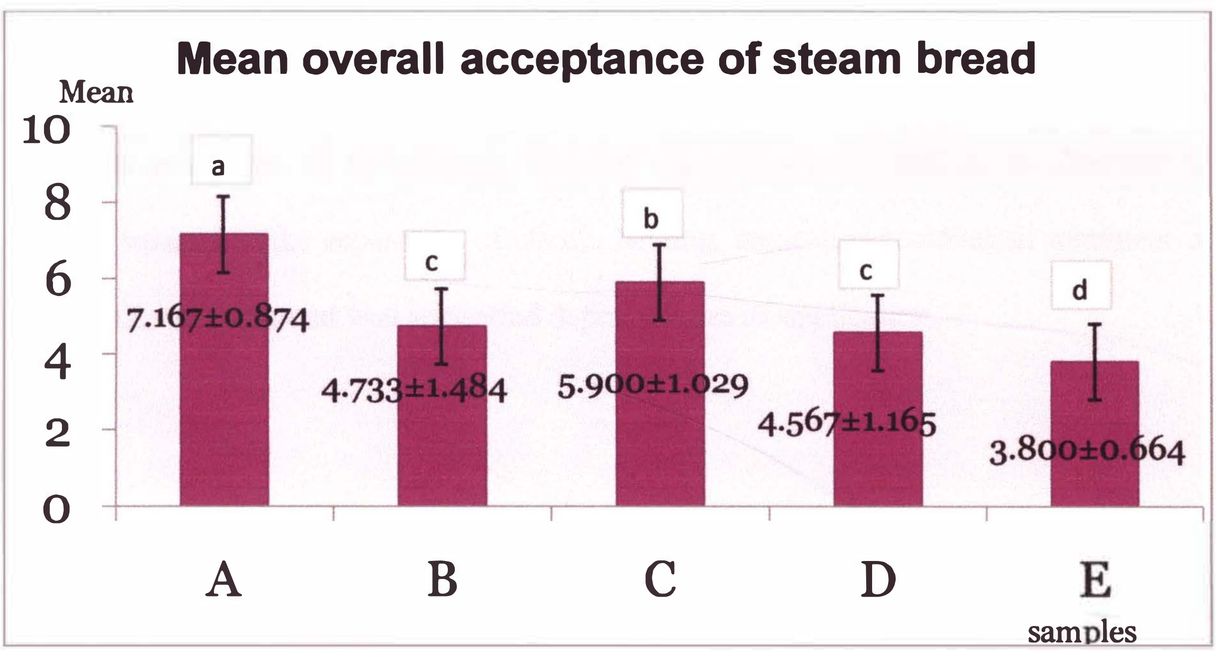
Graph 4.12 : Mean Elasticity of Steam bread



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

For the chewiness also have significant difference. For sample A (6.533± 1.332) while sample B (5.067± 1.337). The results showed lowered for sample E (4.167±1.234) Means that the chewiness reduced when the PSP flour added to the formulation. This is due to the low fat content in the flour and the high fiber content make it absorbed the oil/lipid that present in the bun contributed to the reduction in chewiness. Elasticity of the bread also effected when the flour is incorporated. Results showed for sample A (6.667±1.213), while for sample B (4.960±1.605). Fiber content absorbed the lipid content make it reduce the fat content. It also disturbs and cut the gluten formation and effect the elasticity of the steam bread.

Graph 4.13: Mean of Overall Acceptance of Chinese Steam Bread (CSB)



A: 0% of PSP flour, B: 0.2% of PSP flour, C: 0.4% of PSP flour, D: 0.6% of PSP flour, E: 0.8% of PSP flour

For the overall acceptance showed that the sample A (7.167 ±0.5700), B (4.733 ±1.484), C (5.900 ±1.029), D (4.567 ±1.165) and E (3.800 ±0.660).

Chapter 5

Conclusion

This research is about the evaluation of the physicochemical properties of the Chinese steam bread when incorporated with the PSP flour. Results showed that these bread contains a high nutritional value (result in functional fiber and protein). Results also showed that the bread that was incorporated with PSP flour exhibited considerably a moderate sensory acceptance for the color, odor, hardness, chewiness and elasticity when more flour is added to the formulation. Therefore, PSP flour could be used as replacement for other chemical flour with addition of high fiber properties. In order to improve the functional properties of this fibrous material other treatment such as in chemical or physical treatment like separation of starch, heating, sonication, acid/alkali treatment or combination of treatment was suggested depending on its application.

5.1 Suggestions

Due to the research on the *P. speciosa* steam bread, there are suggestion that may be can contribute to the quality of the steam bread. Especially this steam bread could be proceed to check on the shelf life of the steam bread when incorporated with the *P. speciosa* pod flour. On the other hand, investigation in the effect of *P. speciosa* pod flour size on the properties of Chinese steam bread volume also can be a further study. Furthermore, utilization of the *P. speciosa* pod flour to the other product that does expand properties cookies. PSP flour could also be used as a replacement in bakery or pastry product.

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DEVELOPMENT AND PHYSICOCHEMICAL PROPERTIES OF CHINESE STEAMED BREAD INCORPORATE WITH PARKIA SPECIOSA POD FLOUR - WAN MAISARA WAN KAMARUDIN