PRODUCT DEVELOPMENT OF CHOCOLATE FLAVOURED RICE SOY MILK

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ABSTRACT

Product is developed using blank upland rice, soy bean, cocoa powder and sugar to substitute milk product for people who are lactose intolerance, milk allergy and vegan. Formulation F2, F4 and F7 of milk sample was chosen as best three formulations out of nine formulations in BIB Ranking Test. 7-Point Hedonic Test help in selections of formulation F4 of milk sample as the best formulation. Formulation 4 obtained highest mean score in taste, texture and overall acceptance. Proximate analysis carried out on formulation F4 and also a control to compare the difference among them. The milk sample contain 76.20±0.034% of moisture, 0.38±0.906% of ash, 1.35±0.018% of fat, 2.11±0.016% of protein, 1.92±0.352% of dietary fibre and 18.04±0.744% of carbohydrate. Milk sample has total energy value of 96.59 kcal or 408.82 kJ per 100ml which lower than in control. Microbiological test was carried out for both total colony count in both total plate count and yeast and mould count. pH value is found to increased first from 6.72±0.006 to 7.05±0.006 and decreased back to 5.92±0.300 along the storage period. Milk sample is found unsafe to be consumed after 5 days of storage. Pair comparison test was done to find out differences between fresh and storage sample from aspects of appearance, taste, texture, aroma and overall acceptance. Result showed that majority of panellists can spot the difference between fresh and day-5 sample. Consumer test shows 91% of consumers like the product and 56% is willing to buy it if it can be found in market.

ABSTRAK

PEMBANGUNAN PRODUK SUSU BERAS KACANG SOYA BERPERISA COKLAT

Produk susu dihasilkan dengan menggunakan beras bukit hitam, kacang soya, serbuk koko dan gula. Ia bertujuan untuk mengganti produk susu supaya dapat diminum oleh orang yang intoleransi laktosa, alahan susu dan vegan. Formulasi F2, F4 dan F7 telah dipilih sebagai tiga formulasi terbaik daripada 9 formulasi dalam Ujian Pemeringkatan BIB. Sampel susu F4 telah dipilih sebagai formulasi terbaik melalui Ujian Hedonik. F4 mempunyai skor min yang tertinggi dari segi tekstur, rasa dan penerimaan keseluruhan. Analisis proximat dijalankan ke atas sampel susu dan piawaian untuk membandingkan perbezaan antara mereka. Sampel susu didapati mempunyai 76.20±0.034% kandungan kelembapan, 0.38±0.906% kandungan abu, 1.35±0.018% kandungan lemak, 2.11±0.016% of protein, 1.92±0.352% serabut kasar and 18.04±0.744% karbohidrat. 100 ml Sampel susu mempunyai jumlah tenaga sebanyak 96.59 kcal atau 408.82 kJ dan ini adalah lebih rendah daripada jumlah tenaga dalam piawaian. Ujian mikrobiologi dijalani ke atas sampel susu merangkumi Jumlah Kiraan Plat dan juga kiraan koloni yis dan kulat. Nilai pH sampel didapati meningkat dari 6.72±0.006 kepada 7.05±0.006 dan menurun balik kepada 5.92±0.300 sepanjang tempoh penyimpanan. Sampel susu didapati tidak selamat untuk diminum selepas 5 hari simpanan. Ujian Sensori Perbandingan Berganda dilakukan untuk mengetahui perbezeaan antara sampel segar dan sampel penyimpanan dari segi penampilan, rasa, tekstur, aroma, dan penerimaan keseluruhan. Keputusan menunjukkan bahawa majority ahli panel dapat mengesan perbezaan di antara sampel segar dengan sampel yang disimpan selama lima hari. Ujian Sensori Penerimaan Pengguna dijalankan dan keputusan menunjukkan bahawa 91% pengguna amat menyukainya dan 56% pengguna akan membelinya jika ia didapati di pasaran.

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LIST OF SYMBOLS

℃	Celcius
g	gram
ha	hectare
kcal	kilocalorie
kg	kilogram
<	less than
L	liter
m	meter
mg	milligram
ml	milliliter
%	percentage
sq.	square
t	tonnes

LIST OF ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
ANOVA	Analysis of Variance
BIB	Balanced Incomplete Block
CFU	Colony-Forming Unit
FAO	Food and Agriculture Organization
IRRI	International Rice Research Institute
LDL	Low-Density Lipoprotein
LSD	Least Significant Difference
MOH	Ministry of Health
NRV	Nutrient Reference Value
PCA	Plate Count Agar
PDA	Potato Dextrose Agar
SPSS	Statistical Package for the Social Sciences
TNTC	Too Numerous To Count

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CHAPTER 1

INTRODUCTION

1.1 Background

Lactose maldigestion problem become most common disease in all over the world. From the report done by Vesa *et al.* (2000), it showed that there are people above 50 percent in South America, Africa and Asia, 15 percent among whites, 53 percent of Maxican American and 80 percent Blacks in United States, 2 percent in Scandinavia to about 70 percent in Sicily in Europe, 6 percent in Australia and last, 9 percent in New Zealand showing symptoms of lactose maldigestion. Fidning by Asmawi *et al.* (2006) showed that 300 Malaysian subjects indicating there consist of 88 percent of Malays, 91 percent of Chinese and 83 percent of Indian in Malaysia were lactose intolerance.

Lactose is a kind of disaccharide consisting glucose and galactose (Heyman *et al.*, 2006) and in intestine, it requires to be hydrolyzed by β-galactosidase which termed as lactase-phloritzin in hydrolase (EC 3.2.1.23/26), generally named lactase (Vesa *et al.*, 2000). Lactose intolerance is due to the inequality between number of lactose intake and quantity of existed lactase to hydrolyze it. Intake of Lactose by specific people who is lactose intolerance will have symptoms such as abdominal pain, diarrhea, nausea and so on (Heyman *et al.,* 2006).

Besides, many people have also suffered from milk allergy. Milk allergy refers to extreme response by adverse body's immune system toward protein in milk (Anderson *et al.*, 2010). This happens due to the unavailability of immune system to recognize

milk protein as being harmless and will try to eliminate it. Bovine's milk allergy is most commonly occurred and can be caused by Immunoglobulin E (IgE)-mediated or non-IgE-mediated reactions. IgE-mediated allergy occur when organism unsuccessful to tolerate toward food allergens such as casein; a type of protein in milk where as non-IgE-mediated allergy develops is less well understood (Benbamou *et al.*, 2009). The symptoms caused by IgE-mediated bovine's milk allergy comprise cutaneous such as eczema, gastrointestinal such as nausea or vomiting and respiratory manifestation such as rhino conjunctivitis (Crittenden *et al.*, 2005).

People with lactose intolerance and milk allergy are usually avoiding consumption of milk and dairy products. However, milk and dairy products are much important to human body. Research indicates that milk rich in nine essential nutrients such as protein, vitamin A, Vitamin D, vitamin B12, riboflavin, niacin, calcium, potassium and phosphorus. Deficiency intake of those dairy nutrients can cause disease like hypertension, obesity, diabetes and others (National Medical Association, 2009). Thus, milk-substitute products are much needed to minimize the risk of nutritional deficits. This thesis paper work will be developing a new milk formulation using traditional black upland rice, soy bean and cocoa powder which are lactose-free and gluten-free.

The new milk formulation also can be the non-diary milk substitute for vegans. Vegans are people who not only eliminating intake of flesh products such as beef, pork, chicken, fish, wild or domestic game and so on but also milk, eggs and others animal products (Marcus, 2001). By regular intake of the new milk product, vegans can obtain all of the essential nutrient they needed for health.

Soy is added in the formulation to due to its high content of protein, fats, carbohydrates, dietary fiber, vitamins and minerals. Soybeans are well known to be rich in different types of isoflavones (IFs) such as daidzein and genistein which can helps in prevention of hormone-related cancer, cardiovascular disease, hypertension and so on (Zhou and Boocock, 2006). Soy milk consists of liquid extract of soybean and can be consuming as a nutritional beverage (Golbitz *et al.*, 2006). Soy milk not only contains nearly equivalent amounts of protein in bovine's milk but also have more Iron (Fe) and fiber content than bovine's milk (Loo, 2009), thus it is suitable to fill up the deficiency of protein and enhance the nutritional value of this milk formulation .

The addition of cocoa powder in the formulation is carrying out to enhance the aroma and flavour of rice soy milk. Frauendorfer *et al.* (2006) described that cocoa powder contains about 35 odor-active constituents such as 4-hydroxy-2,5-dimethyl-3(2H)-furanone which contributing caramel-like flavour to cocoa powder whereas phenylacetaldehyde make cocoa powder have honey-like taste. Besides, 31 types of aroma compounds have found in cocoa powder, for example like 3-methybutanal and 3-methylbutonic acid which contributing malty aroma to cocoa powder. Research has showed that school children prefer flavoured milk especially chocolate flavor than plain milk (Babolian Hendijani *et al.*, 2010). Thus, by adding cocoa powder into the milk formulation can help to increase the preference of consumer and further to increase the market value of this milk product.

According to Lehr and Chang (2010), Malaysian has consumed about 1000 million litres of milk per annum. However, milk production in Malaysia only achieves about 56m liters per annum, which is equal to a self-sufficiency index of about 5 percent. Thus, our country has to import the rest of the milk from New Zealand, Australia and European Union to sustain for the demand of Malaysian. Constrain of dairy industries in Malaysia may due to the warm and humid climatic conditions which

unlikely for milk production (Warr *et al.*, 2008). Since the weather in Malaysia is suitable for cultivation of rice, rice milk can be produce as a milk-substitute product to reducing the cost needed in importing of milk.

1.2 Objectives

a. To produce chocolate flavoured rice soy milk from black upland rice and soybean.
b. To determine the percentage of black upland rice, soybean, sugar and cocoa powder required to produce good quality chocolate flavoured rice soy milk.
c. To determine the proximate value and the shelf life of chocolate flavoured rice soy milk.
d. To determine consumers' level of acceptance towards chocolate flavoured rice soy milk.

1.3 Rationale

Malaysian consumed 1000 million litres of milk per annum. However, milk production in Malaysia only achieved for 56 million litres per annum, which can only support for 5 percent self-sufficiency index (Lehr and Chang, 2010). Malaysia has to import milk and dairy product from other countries like New Zealand, Australia and European Union. Therefore a new formulation of milk substitute product can be developed to fulfill the demand. Besides, high yield of upland rice is possible in Malaysia since large track of idle lands has found in Penisular Malaysia and the rice is cultivated in dry land without accumulation of water

CHAPTER 2

LITERATURE REVIEW

2.1 Rice

Rice *(Oryza sativa* L.) is plant under the family grasses, Gramineae (Poaceae). It act as one of the major food crops and become the staple diet in supplies approximately 20 percent of dietary energy worldwide and it has even higher proportion is Asia with an average share of around 30% in 2000 (Frei and Becker, 2005). Rice has been estimated to produce about 650 million tones globally and about 156 hectares of rice cultivation area all around the world. Among all the areas, Asia as the main rice cultivation area and have contribute in 90 percent of the world's production. As people in Asian countries have consumed 75 percent of the world rice supply, rice plays an important role to food security of Asia (Fairhurst and Dobermann, 2002).

The genus *Oryza* belongs to the tribe Oryzeae of the family Poaceae. Oryzeae tribe contain 12 genera and the genus *Oryza* comprise about 22 species, in which 20 are wild rice species and the other two are cultivated, termed as *O. sativa* and *O. glaberrima* (The office of the Gene Technology Regulator, 2005). Randhawa *et al.* (2006) described that *O. sativa* is grown in Asia and has been spread to all over of rice growing areas in different countries including North and South American, European Union, Middle Eastern and African where as *O. glaberrima* is normally grown in western tropical Africa.

It has been proved that *O. sativa* is originated from foothills of Himalayas in the North and hills in the North-east of India to mountain ranges of South-east Asia and South-west China, while delta of Rive Niger in Africa is the place of origin for *O. glaberrima* (Warrier *et al.,* 2011). These places are heterogeneity and can be regard as centres of rice diversity. However, this diversity is forfeit quickly due to the shifting of rice growers to modern cultivars (Randhawa *et al.*, 2006).

Some varieties of rice are cultivated in wet-land while some is suitable to cultivate in dry-land (Eβlinger, 2009). Wet-land rice consists of three types which are irrigated lowland rice, rainfed lowland rice and floating rice. The former two are mostly puddled and plants are transplanted. Irrigated lowland rice refers to cultivation of rice in irrigated bunded field. Farmer usually will maintain 5 to 10 centimeters (cm) of water on the field. Rainfed lowland rice is cultivated for at least part of cropping season in rainwater flooded bunded field to water depth over 100cm for not more than 10 days. Floating rice grown in environment which tends to be flooded, the field will suffer from excess water, deep and uncontrollable flooding on a regular basis (Bourman *et al.,* 2007).

Unmilled rice, can also be refer as paddy is harvested when the grains contain 25 percent of moisture and proceed to the milling process. Schramm (2006) stated that rice milling process included removal of husk or shell, the shelled rice is then undergo milling process to eliminate the bran layer and the last step is whitening of rice to achieve market requirement of rice kernel's appearance. When the first outermost layer of husk is removed, black rice is produced and thus can be considered as whole grain rice (kahlon, 2009). De-husked rice is then removed the bran layer without breaking up the endosperm thus produce white rice (Carpenter, 2000). Flows

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