PRODUCT DEVELOPMENT OF BLACK BARIO RICE MILK YOGURT WITH ADDED FRUIT (DRAGON FRUIT)

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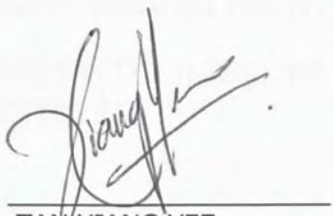

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ABSTRACT

The black barrio rice milk yogurt with dragon fruit is developed and BIB Ranking Test was carried out to find the top three formulations. Formulation 3 was selected as the best from Formulation 2, 3 and 9 using 7-point Hedonic test. This product contains 20.01 ± 0.507% total solid, 9.76 ± 3.839%, 4.52 ± 1.076% fat, 1.53 ± 0.578% protein, 2.10 ± 0.100% dietary fibre, and 2.10% total carbohydrate. Total energy value of the product is 67.8kcal or 282.50kJ per 100ml of yogurt. Initial count of lactic acid bacteria is 3.03×10^9 cfu/ml but it decreases with time of storage with 2.16×10^6 cfu/ml after 16 days of storage. Total yeast and mould count is less than 1×10^2 cfu/ml throughout the 8th day of storage at 4°C. The pH of this product is 4.58 ± 0.058 while the titratable acidity is 0.73 ± 0.012%. The pH of the yogurt decreased during storage, while titratable acidity and syneresis increased. Syneresis was 27.27 ± 1.227% after two weeks of storage. Sensory evaluation using Paired Comparison Test shows that the attributes of the not significantly different at the 1st week of storage. This product is well-accepted as Consumer Test was carried out at Gaya Street, Kota Kinabalu and showed a good response with 85% of respondents liked the taste and appearance of the product.

ABSTRAK

PENGHASILAN PRODUK DADIH SUSU BERAS BARIO HITAM DENGAN TAMBAHAN BUAH (BUAH NAGA)

Produk dadih susu beras barrio hitam telah dihasilkan dan Ujian Pemeringkatan BIB dijalankan untuk mendapatkan tiga formulasi yang terbaik. Formulasi 3 dipilih sebagai formulasi yang terbaik daripada Formulasi 2. 3 dan 9 dengan menjalankan Unjian Hedonik. Produk tersebut mengandungi 20.01 ± 0.507% jumlah pepejal, 9.76 ± 3.839% abu, 4.52 ± 1.076% lemak, 1.53 ± 0.578% protein, 2.10 ± 0.100% serabut diet, dan 2.10% jumlah karbohidrat. Jumlah nilai tenaga produk in adalah 67.8kcal atau 282.50kJ per 100ml dadih. Jumlah kiraan koloni asal bakteria laktik asid adalah 3.03×10^9 cfu/ml yang menurun kepada 2.16×10^6 cfu/ml setelah disimplan untuk 16 hari. Jumlah kiraan koloni yis dan kulat adalah kurang daripada 1×10^2 cfu/ml sepanjang hari penyimpanan yang kelapan pada suhu 4°C. Nilai pH produk adalah 4.58 ± 0.058 manakala asiditi titrat adalah 0.73 ± 0.012%. Nilai pH dadih tersebut menurun sepanjang penyimpanan manakala asiditi titrat dan syneresis telah meningkat. Syneresis adalah sebanyak 27.27 ± 1.227% selepas dua minggu penyimpanan. Ujian Sensori Perbandingan Berganda menunjukkan bahawa tidak ada perbezaan ketara dalam atribut produk and produk tersebut masih boleh diterima selepas satu minggu penyimpanan. Ujian Sensori Penerimaan Pengguna yang telah dijalankan di Gaya Street, Kota Kinabalu menunjukkan bahawa produk dadih susu beras ini boleh diterima oleh pengguna dengan adanya respons baik dan sebanyak 85% daripada jumlah responden menyukai rasa dan penampilan produk yang dihasilkan dalam projek ini.

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LIST OF ABBREVIATIONS

GC	*Gas chromatography*
GI	Gastrointestinal
HDL	High Density Lipid
IFN-γ	Interferon-gamma
LAB	Lactic Acid Bacteria
LB	*Lactobacillus delbrueckii* subsp. *Bulgaricus*
LDL	lipoprotein berketumpatan rendah
LC-MS	*Liquid chromatography–mass spectrometry*
NRV	*Nutrient Reference Value*
ppt	part per trillion
RM	Ringgit Malaysia
Rpm	putaran per minit
ST	*Streptococcus thermophillus*
TA	Titratable Acidity
var.	*variation*

LIST OF SYMBOLS AND UNITS

%	Percentage
% w/w	Mass Concentration
<	Less than
β	beta
γ	gamma
°C	Degree Celsius
µL	microliter
µm	micrometer
cm	centimeter
g	gram
kg	kilogram
m	meter
mg	milligram
min	minute
ml	milliliter
mm	millimeter
nm	nanometer
cfu/g	colony-forming units per gram
cfu/mL	colony-forming units per millilitre

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CHAPTER 1

INTRODUCTION

1.1 Background

In recent years, a considerable growing proneness towards natural and healthy foods has been perceived among the consumers throughout the world, leading to rapid growth in the market for health and wellness products (Hasler, 2002). Consequently, the study and development of new functional foods has gained much importance (Prado *et al.*, 2008). The interest in developing these products is rising day-by-day, driven by the market potential for the foods and beverages that can improve the health and well-being of the consumers (Hilliam, 2000). Generally, an upward trend of the increasingly demanding lives is leading time-pressed consumers to take up simple and convenient prepared meals as the top priority in food choices.

With the growth in food industry and wider range of products available, incorporation of various kinds of alternatives into the typical Malaysian diet should be increased. Ultimately on *Oryza sativa L.* also known as rice and its products since it is a cereal grain consumed as a staple food by almost half of the world populations, including Malaysians. Rice is more than a source of energy. It is a major source of protein, a significant source of fiber and of essential micronutrients include iron, zinc, copper, carotene, anthocyanin, vitamin Bs, and a good source of antioxidants which comprise polyphenols, carotenoids, vitamin E (Frei and Becker, 2009). Rice provides nutritionally significant amounts of vitamin B such as thiamin, riboflavin, and niacin, zinc with lesser amounts of other micronutrients (Rusydi *et al.,* 2011). Rice are classified according to the degree of milling, where the colour of the outer layer (pericarp) can range from black/purple to red and brownish or

colorless (Frei and Becker, 2009), while milled rice is also known as white rice. The predominant form of rice found on today's markets is milled white rice. However, in upland areas where rice is grown traditionally, farmers process their rice manually and remove only the fibrous hull. Rice is then consumed as 'coloured rice', i.e. including the bran layer. Colored rice, especially of those dark colors such as black and dark purple grains, is found to be containing significantly higher antioxidant capacity and phenolic compounds than non-pigmented rice (Norzaleha *et al.,* 2011). However, due to the hard texture, cooked colored rice is not popular for consumption even though it has been long known about the beneficial effects of pigment in these groups of rice (Sutharut and Sudarat, 2012). Rice was consumed every day by a majority (97%) of the population in a survey done by Norimah *et al.* (2008). Cooked white rice, *nasi putih*, was consumed on average twice daily amounting to 2½ plates of rice per day.

The aim of this project is to introduce the consumption of coloured rice through the presentation of a design in producing rice milk yogurt with the locally grown black bario rice grains. Black bario rice used in this development project is locally grown in Sabah which is of the *Oryza Sativa L.* species. Black rice grains differ from white rice by having dark-colored pigments on the bran. Black bario rice, the *Oryza Sativa L. Indica*, contain a much higher level of anthocyanin pigments in the aleurone layer, as compared to other colored rice grains, including the white rice, has been widely consumed as a health-promoting food in China and other Eastern Asia countries for centuries (Wang *et al.,* 2007). An elevated level of β-carotene is also found in dark-colored rice grains, especially the black or purple colored rice grains, thus had high lipid content (Frei and Becker). Apart from β-carotene, black and purple varieties from Malaysia were also found to have elevated concentrations of other carotenoids, especially lutein (Frei and Becker, 2009).

Probiotic dairy foods containing health-promoting bacteria are an important segment of the functional food market (Batish and Grover, 2004), in which yogurt is one of the examples. Yogurt is a food product resulting from the process of fermenting milk with lactic acid bacteria. Typically yogurt is the most easily tolerated fermented foods allowed on the diet. It was reported that almost 75% of Malaysian population, mainly of the Malay and Chinese races, are lactose intolerant, thus consumption of yogurt would be more suitable (Zainoldin and Baba, 2012). In the market there are several cows' milk yogurt alternatives such as the soymilk yogurt, almond milk yogurt, coconut milk yogurt, goat milk yogurt and rice milk yogurt. Yoghurt possesses biochemical and bacteriological characteristics that make it extremely useful in human diets (Everett and McLeod, 2005). Furthermore, they are an economical source of live beneficial bacteria for the human gut, such as the *Bifidobacteria sp.* and the *Lactobacilli* sp., together with the production of antimicrobial compounds, acetic, lactic and benzoic acids. Examples of starter cultures in yogurt production are *Bifidobacterium longum subsp. longum, Lactobacillus acidophilus, Streptococcus salivarius subsp. thermophilus, Lactobacillus delbrueckii subsp. Bulgaricus.* The specific health benefits depend on the strain and viability of the culture in yoghurt (Miller et al., 2008). Yogurt displays excellent nutritional quality can be attributed mainly to the milk, which is a major source of calcium, proteins, phosphorus and riboflavin.

Recent globalized economic status and rising consumer confidence has prompted consumers to be more willing in trying new product innovations. According to recent market research report by Mintel Global Market Navigator, yogurt posted positive growth in 2010 which is partly due to the greater awareness of the health benefits of yogurt among Malaysians. The rise in yogurt consumption is also related to the choices available in the marketplace (Chandan, 2006). Besides plain yogurt, the varieties of flavours, diversification in yogurt market includes variety of textures, packaging innovations to fulfil consumer expectations of health food trends, convenience, and portability. It is also known that familiarity with foods can decrease neophobia, which is the fear of new things or experiences (Pliner and Hobden, 1992), hence yogurt, a familiar food with increasing popularity

is the suitable type of food to be further innovated to introduce consumption of colored rice. In addition, consumption of milk and its products in Malaysia has increased by 3 folds, largely as a direct result of changes in lifestyle and surplus income in the medium-high income population (Zainoldin and Baba, 2012).

The rationale includes the incorporation of non-conventional food sources into yogurt which help to increase the utilization of the selected non-conventional food source and producing nutritious fermented food apart from extending the variety of plain cow's milk yogurt. Black bario rice relatively inexpensive and rich in essential micronutrients, where choice is made with the effort to exploit them for manufacture of acceptable and palatable food products. Replacing a part of milk used in making yogurts with black rice enriches nutritional value of the product. Black bario rice-based foods may provide additional benefits for the consumer for example due to their antioxidant activity, anti-cancer properties, etc. Primary pigments in black and red rice varieties (Abdel-Aal, 2006) and are of increasing interest to the food industry as natural food colorants (Hiemori *et al.*, 2009). They are also recognized as health-promoting functional food ingredients due to their antioxidant activity (Nam *et al.*, 2006; Philpott *et al.*, 2006; Saute-Gracia *et al.*, 1997; Hu *et al.*, 2003), anti-cancer properties (Kamei *et al.*, 1995; Hyun & Chang, 2004; Zhao *et al.*, 2004), hypoglycemic activity (Tsuda *et al.*, 2003), and anti-inflammatory effects (Tsuda *et al.*, 2002; (Hu *et al.*, 2003). The black barrio rice also has higher fiber content than white milled rice due to the amount of total dietary fibre is contributed by the presence of bran layer (Ohtsubo *et al.*, 2005). Rice bran and its fiber components showed anti-carcinogenic and anti-mutagenic activities in in vitro and in vivo studies (Aoe *et al.*, 1993; CIREP, 2006; Hidashi Okai *et al.*, 2004; Sera *et al.*, 2005; Takenaka *et al.*, 1991; Takenaka, 1992; Takeshita *et al.*, 1992), and fecal bulking effects to promote intestinal regularity (Miyoshi *et al.*, 1986; Tomlin and Read, 1988).

Due to the beneficial values black pigmented rice provides, and the increasing popularity of yogurt among health conscious consumers, the preparation of a rice milk yogurt-like product appears to be an interesting approach to the development of new fermented milk products containing probiotic cultures. Thus, the sample black barrio rice milk yogurt with tropical fruit is to be developed from this paperwork, in which this future product can be another alternative to typical cow's milk yogurt range, as breakfast or snack choices. The tropical fruit selected in this development is the dragon fruit or pitaya. Pitaya is the name of the plant, *Hylocereus undatus,* and its fruit (Zee *et al.,* 2004). Dragon fruit has been reported as a source of beta-carotene, lycopene and vitamin E, while its seeds contain 50% essential fatty acids, i.e., 48% linoleic acid (C18:2) and 1.5% linolenic acid (C18:3) (Wichienchot *et al.,* 2010). Thus, dragon fruit has potential for use as a source of functional ingredients to provide nutrients that may prevent nutrition-related diseases and improve physical and mental well-being of the consumers.

1.2 Objectives of Study

i. To produce yogurt from locally grown black bario rice and cow's milk with added fruit.
ii. To determine the percentage of black rice, milk, gelatin and fruit pulp required to good quality fruit yogurt product.
iii. To determine the consumer's level of acceptance towards the product developed.
iv. To evaluate the product produced of the physicochemical properties, nutritional value and microbial activity during storage.

CHAPTER 2

LITERATURE REVIEW

2.1 Fermented Milk

According to the Codex Standard 243 (2003), fermented milk is a milk product obtained by fermentation of milk, which milk may have been manufactured from products obtained from milk with or without compositional modification as limited by the provision in Table 2.1, by the action of suitable microorganisms and resulting in reduction of pH with or without coagulation. Starter microorganisms shall be viable, active and abundant in the product to the date of minimum durability. If the product is heat-treated after fermentation the requirement for viable microorganisms does not apply. This category includes yogurt, kefir, alternate culture yogurt, acidophilus milk and kumys (Codex Standard, 2003), each with its definition of characteristics based on specific starter culture used for the fermentation process.

Table 2.1: Composition of Fermented Milk

Component	Level of Requirement
Milk Protein[(a)] (% w/w)	Min. 2.7%
Milk Fat (% w/w)	Less than 10%
Titrable Acidity, expressed as % lactic acid (% w/w)	Min. 0.3%
Total Microorganisms constituting the starter culture (cfu/g)	Min. 10^7
Labelled[(b)] Microorganisms (cfu/g)	Min. 10^6

Source: Codex Standard 243 (2003).

a) Protein content is 6.38 multiplied by the total Kjeldahl nitrogen determined.
b) Applies where a content claim is made in the labelling that refers to the presence of a specific microorganism that has been added as a supplement to the specific starter culture.

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