The Global Acceptance and Development of Probiotic-Containing Products as Functional Food

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ABSTRACT

Probiotics have been associated with a range of health benefits and have been made available to the consumers via a range of functional food products. However, it has showed that there still a gap between countries in the acceptance to health benefits of probiotics. The national variation in the acceptance and awareness of consumers to probiotic-containing products have affected greatly to the different development of probiotic markets in the world. The global market for this type of functional foods in the coming years is expected to increase significantly. The Asia in general and Japan in particular still is the major market, whereas Europe countries and the US market obtain quickly rate of growth. Several factors affecting the success of probiotic-containing products also are indicated to achieve greater popularity of this type of functional foods.

Keywords*: probiotics, prebiotics, microencapsulation, functional food, potential market.*

Probiotik telah dikaitkan dengan berbagai manfaat kesehataan dan telah disesuaikan dengan kebutuhan konsumen melalui berbagai produk makanan fungsional. Bagaimanapun, hal tersebut menunjukan bahwa masih ada kesenjangan antara negara-negara dalam penerimaan manfaat kesehatan dari probiotik. Variasi nasional terkait penerimaan dan kesadaran konsumen terhadap produk probiotik telah sangat berpengaruh pada perkembangan yang berbeda dari pasar probiotik di dunia. Pasar global untuk jenis makanan fungsional di tahun-tahun mendatang ini, diperkirakan akan meningkat secara signifikan. Di Asia, khususnya, Jepang, merupakan pasar utama sedangkan negara-negara Eropa dan pasar AS melaju sebagai negara dengan pertumbuhan yang tinggi. Beberapa faktor yang mempengaruhi keberhasilan produk probiotik juga di indikasi untuk mencapai popularitas yang lebih besar dari jenis makanan fungsional.

Kata-Kata Kunci: *probiotik, prebiotik, mikroenkapsulasi, makanan fungsional, pasar potensial*

Introduction

The finding of probiotics has leaded to the many important applications towards the development of functional foods in the food industry. The term probiotic are defined as 'live microorganisms which when administered in adequate amounts confer a health benefit on the host' (WHO 2002). The *Lactobacillus* and *Bifidobacterium* species are the most widely used probiotics among lactic acid bacteria (Williams 2010). Health benefits associated with the probiotic have been reported scientifically by many independent research groups in several academic journals. These benefits include lowering intestinal pH, reducing the colonization of pathogenic bacteria, improving the host immune system, treatment some diarrhea types. More researches have suggested that the probiotic activities also positive influence the aiding the lactose intolerance systems, shortening of rotavirus diarrhea (Ouwehand et al. 2002). Therefore, there has been a significant development of the probiotic contained food in various dairy products like yoghurt, dairy drinks and other fermented foods.

The lactose intolerance and cholesterol level are two major disadvantages of dairy products therefore juices are considered as the alternative functional foods containing probiotic. This finding may give opportunities to open huge market in non-dairy consumers. However, it is proved that the probiotics viability decrease in fermented drinks with pH from 4.0 to 5.0 during storage (Champagne et al. 2005).

There are several attempts to improve the storage stability and viability of probiotics in acidic fruit juices, such as generating acid-resistant strains by UV mutagenesis. The reactions and high water content of juice causing the loss of color, flavor, nutrients and spoilage due to the decomposition by microorganisms, chemical and enzymatic reactions. Beside above major problems, the difficulty in transportation leads to the limitation of these fresh products in exportation. It is desirable to produce the probiotics combined in fruit powder to reduce much volume and increase the shelf life as well (Cano-Chauca et al. 2005).

If probiotic amount is taken insufficiently, they will not confer the potential health benefits to the human host (Indian Council of Medical Research Task, Co-ordinating Unit, & Co-ordinating Unit, 2011). The amount of probiotics must be $>10^7$ viable cells per gram or per milliliter of a product to confer benefits to the consumer (Teoh et al. 2011).

Microencapsulation has been demonstrated its functions to protect against the harsh environment like heating, acidity or rancidity until releasing the survival bacteria in the gastrointestinal tract. The alginate was used as the coating due to its safety and being available to improve the survival of probiotics. The emulsion method to encapsulate has been demonstrated as the smooth and gentle processing because its operation is quite easy and it does not apply stress or damage the bacteria cells. The suitable anaerobic environment and the physical barrier provided by the microcapsules may help to protect the sensitive probiotics (Ding and Shah 2008).

Definition of 'probiotic'

Fuller (1989 in O'Sullivan 1992) defined that 'probiotics' as 'a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance'. This definition has been expanded as 'a mono or mixed culture of live microorganisms which, applied to man or animal, affects beneficially the host by improving the properties of the indigenous microflora. Probiotics also are defined as

'viable microorganisms, sufficient amounts of which reach the intestine in an active state and thus exert positive health effects' (Schrezenmeir 2008).

According to Guarner & Schaafsma (1998 in Ouwehand et al. 2002), one definition of probiotics was published as 'living micro-organisms which upon ingestion in certain numbers exert health benefits beyond inherent general nutrition' by an expert committee. Additionally, the inactivated bacteria or their cell structure also have been determined their benefits on human by Japanese scientists (Lee and Salmine n.d in Ouwehand et al. 2002). Therefore, the definition of probiotics may be changed due to expending and additional investigation on their beneficial effects.

Distinguish with other bacteria and prebiotic

Prebiotics are defined as 'selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal micro flora that confers benefits upon host wellbeing and health' (de Vrese & Schrezenmeir 2008). They are fibres including bifidogenic, non-digestible oligosaccharides, for example, inulin, oligofructose, lactulose, (trans-) galactooligosaccharides. The prebiotics have to non-digestibility, fermented by the intestinal microorganisms and stimulate selectively microbial growth. Schrezenmeir and Verse (2008) also defined synbiotics as the synergistic combination of probiotics and prebiotics. Anderson et al. (n.d) defined synbiotics as mixtures affect positively on the gastrointestinal tract of the host.

General benefits of probiotics

O'Sullivan et al. (1992) states that probiotic bacteria have antimicrobial properties that is responsible for the inhibition of pathogenic bacteria and urogenital colonization as well. The competition for foods and adhesion places or the produced metabolites like organic acids, hydrogen peroxide, bacteriocins and deconjugated bile acids from probiotics results in their applications in treatment some diseases. Schrezenmeir and Verse (2008) also found out that the probiotics have positive effects of treatments on inflammatory diseases of gastrointestinal tract, Helicobacter pylori infection or organism survival.

Ouwehand et al. (2002) agree that the probiotic consumption help to prevent the pathogen's colonization and decrease the growth of bad bacteria. Williams (2010) states that the lactic acid, acetic acid and propionic acid produced from probiotics resulting in the lower intestinal pH and pathogen prevention.

The partial fermented lactose due to the starter bacteria is demonstrated to improve the lactose tolerance in lactose-intolerant people. Another reason is that the production of lactase in the gut by the bacteria from the fermented food (O'Sullivan et al. 1992). Schrezenmeir and Verse (2008) suggests that β-galactosidase in fermented products is liberated to improve the lactose digestion in the intestine. It is also argued that this is not the major benefit of probiotics because this property does not base on the survival of bacteria, for example, some probiotic strains show weak β-galactosidase property although they have high acidity and bile salts resistance.

Ouwehand et al. (2002) also agree that the β-galactosidase is liberated from the bacteria cells due to ingestion. The major strains used for this property is *L. Delbrueckii*

ssp. *Bulgaricus* and *S. Thermophilus*. In contrast, the lactose-fermenting property is not available in some strains like *L. Rhamnosus GG*.

Global development of probiotic-containing products

Probiotics containing products are categorized as functional food. This category was predicted that even though Japan market takes in about one-half, the fastest rate of growth was expected to be in the United States (Stanton et al. 2001). The global sales of probiotic ingredients, supplements, and foods were reported $21.6 billion in 2010 and $24.23 billion in 2011. The leading developers and suppliers of probiotic strains for functional food suppliers and manufacturers include Danisco (Denmark), Chr. Hansen (Denmark), and BioGaia (Sweden).

According to a new market report published by Transparency Market Research, "Probiotics Market (Dietary Supplements, Animal Feed, Foods & Beverages): Global Industry Analysis, Market Size, Share, Trends, Analysis, Growth and Forecast", the global sales of probiotic products are predicted to achieve $31.1 billion by 2015 with a compound annual growth rate (CAGR) of 7.6% in the first 5 year period and it would reach US$44.9 billion in 2018.

The overall probiotic yogurt market is expected to reach a market size of $11.8 billion by 2017 growing at a CAGR of 5.2% from 2012 to 2017. The market for overall probiotic products was $24.23 billion in 2011 and is expected to grow at compound annual growth rate (CAGR) of 6.8% from 2012 to 2017 to reach a size of $36.03 billion by 2017. According to Diana Cowland (2013), probiotic and prebiotic yoghurts is predicted to grow up 4% from a base of $26.8 billion in 2012 and would be set to remain the second fastest growing functional food category over 2012-2017 with the growth of $8.7 billion. And the US, Brazil and China will be the top countries with witness constant value growth of over $300 million.

Legislation on functional foods of different countries and regions

The United Nation's Food and Agriculture Organization (FAO) defines probiotics as 'live microorganisms, which when administered in adequate amounts confer a health benefit on the host.' However, no legal definition of probiotics exists in any country. This allows the marketing of products labeled as probiotic that do not meet the fundamental criteria stipulated in the scientific definition.

Asia-Pacific is currently the largest probiotics market, owing to the Japanese market due to its high awareness of the benefits of probiotic products and fermented milk. Asia-Pacific is predicted with CAGR of 7.0% from 2013 to 2018. China and Japan keep the leading positions of the market revenue for probiotics, followed by India and other regions.

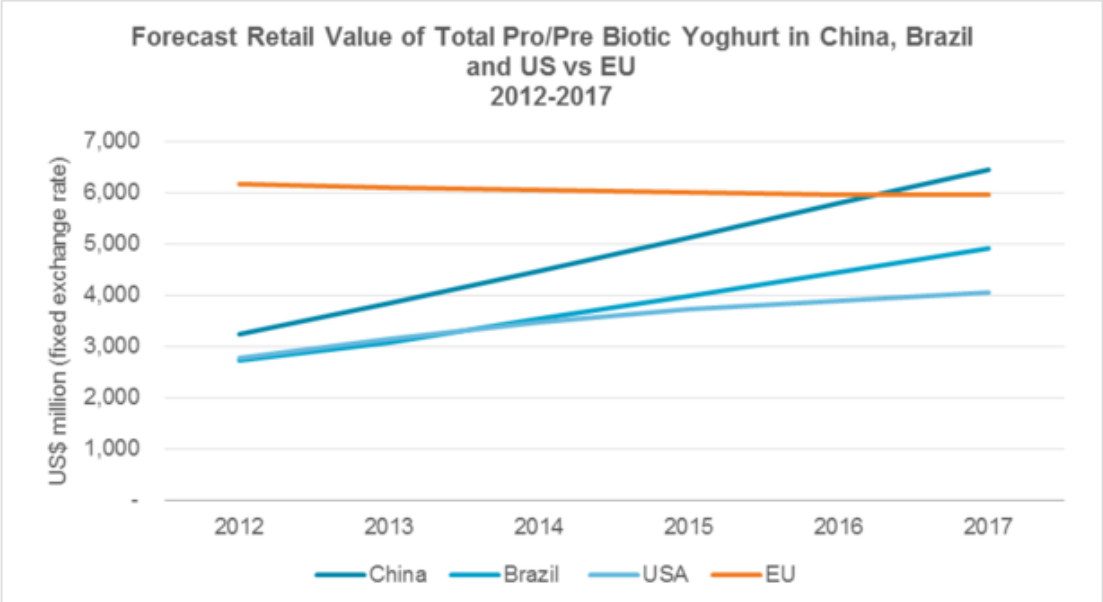
In term of **Japan**, the functional food products were accepted legally in 1991 as FOSHU describing foods for specific health use. A FOSHU has been licensed to have a label to the specific health benefits. To achieve FOSHU status, the health influences must be proven scientifically but these health claims are not the curing of any diseases. At that time, FOSHU food category contains neutraceutical ingredients such as peptides, proteins, n-3 and n-6 fats, oils, sugar alcohols, oligosaccharides and lactic acid bacteria (Stanton et al. 2001)

Europe is another major market of probiotic containing products because of higher consumer awareness than in North America. During 1977, there was more concentration on the launch of prebiotic foods in dairy products. In the late 1990s, the regulatory status, policy statements and claims of health benefits from functional foods were addressed in Europe and US. In comparison with the situation in the US at this time, the awareness and acceptance of consumers about probiotics and prebiotics are higher even though there were also no specific regulations or legal definition of functional foods in both Europe and the US. The reasons are high interest in foods claiming health benefits and relationship between diet and health of European consumers. In 1997, the probiotic yoghurts and milks made up 65% of the European functional foods market with US$889 million, the probiotics spreads ranked the second with 23% of the market (US$320 million). In this year, there was also a study about the market for functional foods from the United Kingdom, France, Germany, Spain, Belgium, Netherlands, Denmark, Finland and Sweden conducted by Leatherhead Food RA. It was showed that the total probiotic yoghurt made up more than 250 million kg. In particularly, France ranked the first with the sale of nearly 90 million kg whereas both Finland and Sweden took the lowest value in this market. Especially, the Yakult-fermented milk from Japan which is categorized as functional food in Europe but no regard in Japan because the presence of probiotics in isolation from other functional ingredients does not carry functional food status in Japan. Some emerging probiotics yogurts and fermented milk in the EU market include LCI (Nestle, Vevey, Switzerland), Vifit (Campina Melkunie, Netherlands), Actimel (Danone, Paris) and Yakult from Japan. Yakult was introduced to UK market from 1996 as 'containing beneficial live bacteria' fermented milk drink and then doubled its sales in the yogurt and ready-to-eat dairy dessert market.

There are also significant differences in the health benefits preferred by consumers from different European countries. Therefore, the national variation would affect dramatically to the planning and strategies of functional foods development in any country of Europe. For instance, the UK consumers prefer health benefits to heart disease whereas the German consumers concentrate to general disease resistance. Functional foods in the European Union also are regulated by the Food Labeling Regulations as the manufacturer is not allowed 'to attribute to any foodstuff the property of preventing, treating and curing a human disease, or refer to such properties'.

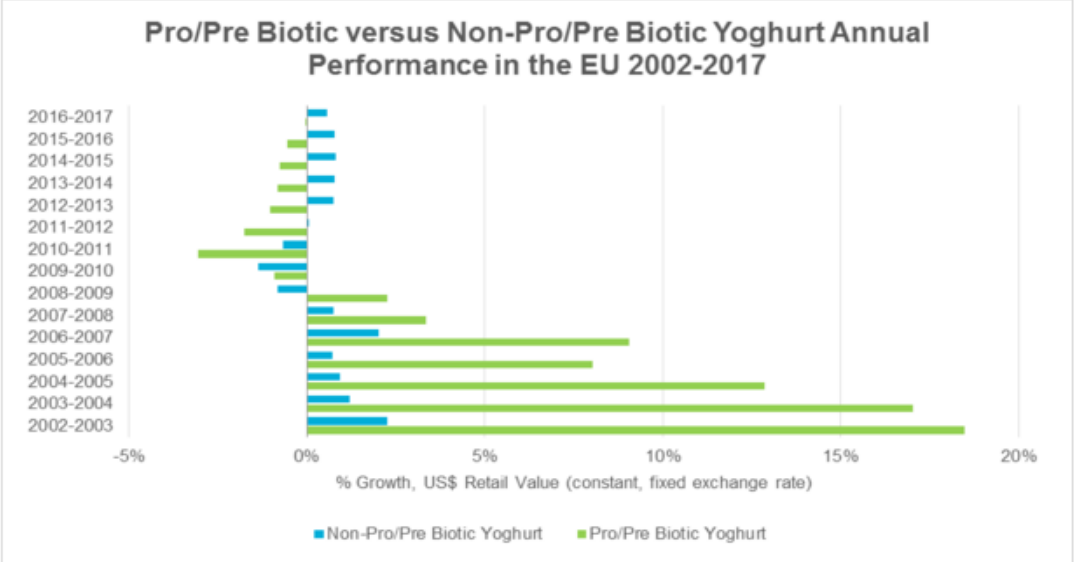
The CAGR of European market is expected to be about 6.7% from 2013 to 2018 with over 6% each for Germany and UK-the most popular markets (Stanton et al. 2001). However, according to Cowland (2013), there is a fall in pro/prebiotic yoghurt of 1% for the EU market. Therefore, digestive products in the EU should be reformulated or promoted with changing marketing strategies or looking to move into new markets as the author recommended.

Figure 1.
Forecast retail value of total pro/prebiotic yoghurt in China, Brazil and US versus EU



Source: Euromonitor International 2013

Figure 2.
Pro/prebiotic versus Non-pro/prebiotic yoghurt annual performance in the EU



Source: Euromonitor International 2013

As can be seen clearly from the above chart, there was historically strong constant value annual growth which significantly outpaced non-pro/prebiotic yoghurt. There will be a recovery from tight consumer spending after the onset of the recession, but probiotic yoghurt is set to remain in downward from 2012 to 2017. Meanwhile, there are significant increases in retail values of total digestive yoghurt products in China, Brazil

and USA, especially nearly double in China from around $3500 million in 2012 to$6500 million in 2017.

However, despite of the huge market of probiotic foods in Europe, there is no specific regulations regarding the labeling of these products exist in that region. The failure of the European Food Safety Authority (EFSA) to give approval for a generic health claim for the ingredient of probiotic containing products in 2012 surprised those in the major of probiotics. Therefore, only approved claims have been permitted on products since December 14, 2012 and most of the probiotic yoghurt manufacturers began removing probiotic labels from their products excepting some yogurts on sales in the UK's supermarkets, for example Lancashire Farm yogurts.

Alternatively, there are three strategies to companies to retain a health positioning to appeal consumers in the light of legalization of article 13.1. These strategies allow the company to maintain the association with probiotics and their health benefits. (1) Remove the term 'probiotics', and replace by the name of strain of probiotics or use the words 'bio live' or 'live'. For example, Activia's *Bifidus Actiregularis* or Yakult's *Lactobacillus casei Shirota*. (2) Reformulation provides an opportunity to develop consumer attention and knowledge of health benefits from pro/prebiotics containing products compared to other ingredients. (3) Delivery systems as microencapsulating technologies and other advanced systems could play an important role to open the opportunities of achieving an authorized health claim.

However, at a European Commission (EC) and the UK's Department of Health (DH) working group meeting on nutrition and health claims in March 2013, the use of the word probiotic as a 'generic descriptor' for food products was accepted. There are also debate concerns whether generic descriptors 'could imply an effect on health' or not.
In **Ireland**, when no probiotics and prebiotics have yet won a digestive, immunity or other health claims under the EU Nutrition and Health Claim Regulation (NHCR), the terms like 'probiotic' or 'live cultures' are banned in marketing and promotional materials to consumers. A following statement about this matter was issued by an agency called The Food Safety Authority of Ireland (FSAI):

> *"Stating 'contains probiotic' on a product is not the samr as saying 'contains ingredient X'. Anything that states, suggests or implies a relationship between food and health can be considered to be a health claim. For this reason, the term 'proiotic', when used on a food label, is considered to be a health claim. Any terms that imply probiotic activity (i.e. imply that the bacteria in the product maybe beneficial for health) are health claims and are not permitted".*

However, the individual probiotic strain name is not required to be listed on the label but manufacturers can choose to give this information voluntarily (Starling, 2013).
Switzerland, non EU member state, have issued a number of approvals for probiotic category leader.

The United States of America functional foods market, especially prebiotics-containing product was lack of development compared with the EU market. The U.S market is also increasing significantly because of the general attraction of the U.S population towards the probiotic dietary supplements and the concept of preventive health care. There was 70% of American shoppers believe that foods containing active ingredients could reduce the disease and improve their health. The number of news reports and conference about functional foods and neutraceuticals reflected the higher

interesting in functional foods in US. The probiotic-containing foods could categorized into some of four food categories defined by the US Food and Drug Administration (FDA) but no recognition of any health claims of probiotics, prebiotics as well as cultures-added dairy foods in the US at this time. The label and marketing of sold conventional foods containing probiotics are regulated strictly by the FDA even though the US market has not well developed as Europe. There is an example of indirect claims could be made with limited benefits as 'contains acidophilus and bifidobacteria which are considered normal inhabitants of a healthy intestinal flora' (Stanton et al. 2001).
In term of **Canada** market, the Federal Canadian health department has approved two more health claims to Pharmax's proprietary human lactic commensal (HLC) probiotics, HLC Intensive and HLC Replenish. That is "*Significant reduction in the symptoms of irritable bowel syndrome"* and "*Effective supplementation of normal intestinal microbiota following antibiotic therapy"* (Daniells 2013).

Some reports also have predicted the market forecasts of **North America and Brazil** is one of the huge potential market for increasing demand.

In **South Africa**, the statements regarding to the health claims of probiotic and prebiotic are announced in proposed regulations governing labeling and advertising in the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972). It is another story in South Africa, even though these regulations are being finalized; there is lack of available information of the probiotic and prebiotic-containing products in South Africa market (Brink et al. 2008).

Potential development of probiotic-containing products

The probiotics market now also pay attention to pro/pre biotic milk formula and probiotic juices studied as other suitable vehicles for probiotics. For instance, HJ Heinz Co's Golden Circle Healthy Life juice in Australia, the Good Belly Company's probiotic coconut water in US (Cowland 2013).

Analysis of the different situations in the main countries regarding the probiotic market shows the market is divided between the different fields of application for probiotics and that there are differences from one country to another. Consumer awareness plays an important role in significant development of probiotic market in one country. Furthermore, pricing issues, culture cultivation and lack of standardization of product specifications are difficulties that some countries have to face to grow market over next five years.

The long term development of functional products in general and probiotic-containing products in particularly is affected by following factors including sound, scientifically proven clinical evidence of health promoting activity, accurate consumer information, effective marketing strategies, quality of products to satisfy consumer expectation. The demand for these products only increases when the consumers become more familiar and accept the health benefits of probiotics (Stanton et al., 2001)

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