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# Drivers of Industry Convergence: The Case of Functional Food Industry in Indonesia

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# JOURNAL OF SCIENCE, TECHNOLOGY AND INNOVATION POLICY AND MANAGEMENT (STIPM JOURNAL), Volume 04, Issue 01, July 2019

## FOREWORD by EDITOR-in-CHIEF

We are very pleased to inform the readers that Journal of *Science, Technology, & Innovation Policy and Management* (STIPM Journal) Vol. 4, No. 1, July 2019 edition is now ready for public reading and views. STIPM Journal is an online research journal managed by the Research Center for Science, Technology, and Innovation Policy and Management, Indonesian Institute of Sciences (RC-STIPM-LIPI).

The journal provides scientific information that needed mostly by the research scholars as well as STI policy makers. As a peer reviewed journal, STIPM provides free access to research thoughts, innovation, and original discoveries. In this issue, we bring together research findings on development and adoptation of science, technology, and innovation policy and management from Malaysia and Indonesia.

First article is composed by **Wati HERMAWATI** entitled *Technology Transfer from Public Research Institute to Community: A Case Study*. This research article examines the technology transfer mechanisms into practical applications of the community. The success of technology transfer to community itself were demonstrated by the increased ability of recipients namely SMEs and farmers to replicate the technologies, increased their production, enlarge their market as well as increased new knowledge, skills, and productivity.

Second research article entitled *A Scientometric Study on Biodiesel Development in Indonesia*. This article is presented by **Mesnan SILALAHI et al.** The article describes the results of scientometric studies in the energy sector, especially in the field of biodiesel in Indonesia by using a mixed method through content analysis and in-depth interview. Quantitative research uses bibliometric basics and content analysis, where text mining is triangulated with the results from in-depth interview with several prominent Indonesian researchers in this field. Content analysis is conducted by topic modeling method by analysing the papers' abstract. This article reports on the results of a scientometric study, based on publications indexed in Scopus in the energy sector, especially in the field of biodiesel in Indonesia.

**Nor Ashikin Mohamed YUSOF et al.** present an article entitled *Theoretical and Practical Gaps in Policy Making Process in Five Organizations*. This article reports case studies involving five national policy documents and internal policies at several key governmental department and organizations. The findings from the study enables the researchers to make a comparison between the theory of policy making and the practice of policy making in Malaysia. The findings show that there is still a huge gap between theory and practice in policy making and policy studies in Malaysia.

The fourth article with the title *Innovative Strategy to Disseminate Science Information to Policy makers* is presented by **Azmi HASSAN.** There exists a huge gap between science and technology discovery and the formulation of public policy mostly due to the poor understanding on how to disseminate the

news not only to policy makers but also to the general public. To bring accurate, relevant information from the front lines of research to the policy makers, this paper describes how innovative strategies that use the media as the conduit are formulated in more systematic ways.

**Dian KUSUMANINGRUM et al.** present an article entitled *Structural Equation Model: Intention to Use Mobile Banking of Bottom of Pyramid Customer*. The purposes of the study are to identify the predicting factors influencing the intention to use mobile banking and empirically validate a model explaining the behavioral intention to use it, especially on the bottom of pyramid (BOP) segment. The model used was structural equation model (SEM) based on partial least square (PLS). The data used for developing the model was based on a survey to 100 BOP households. The results show that the variables that have the highest significant effect on BOP's customer intention to use mobile banking are involuntary barriers, followed by perceived risk, and attitude. This result can be further used by researchers and mobile banking providers to evaluate the existing mobile banking services to improve its contribution in providing better market penetration and more appropriate financial services for BOP and ultimately financial inclusion in Indonesia.

Lastly, **Karlina SARI et al.** present an article entitled Indonesia in *Functional Food Industry: Market or Player?* This paper presents the overview of functional food industry in Indonesia. It analyzes the prospect of Indonesian functional food industry from demand, supply, and regulation perspective. The result of this study is Indonesia should have a good prospect as both the market and the player in functional food industry. Currently, baby food and toddler are Indonesia's biggest market of functional food for baby formula milk and baby food. Another functional food market segment prospective to be penetrated is elderly who have bigger risk of disease, such as hypertension and arthritis

The journal is indexed by Google Scholar, ISJD, IPI, DOAJ, BASE, and OCLC World Cat, which makes wider journal dissemination. We would like to express our immense gratitude to our international editorial board members, reviewers, and authors for their contribution to this issue. We hope this publication will prove useful for readers and contribute to the enhancement of science, technology, and innovation. We expect that STIPM will always provide a higher scientific platform for authors and readers with a comprehensive overview of the most recent STI Policy and Management research and development at the national, regional, dan international level.

Jakarta, July 2019

Editor-In-Chief

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# Drivers of Industry Convergence: The Case of Functional Food Industry in Indonesia

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**ABSTRACT**

Food industry has been considered an industry with low-intensity research and low R&D-to-sale ratio. However, the advancement of biotechnology and genomics has generated a new technology platform for food industry. Technology innovation and the changing preference of food consumers have driven the industry convergence of foods and pharmaceutials to become a new functional food industry, where the food processing involves a new scientific and technical approach. Changes in the environments of food industry, changes in society's lifestyles, the rise of world's food consumption, a shrinking food production base, and changing perspective of society toward the consequences of the food system's sustainability have also encouraged this industry convergence. Budget deficit in public healthcare has urged Indonesian government to develop functional food as their long-term prevention strategy. However, the strategy has not presented the development of the functional food industry itself. This paper provides the overview of functional food industry in Indonesia, from the scientific, technology, market, and regulation aspects. The result of this study is that Indonesia is a suitable place to develop functional food industry, although the science and technology aspects are lacking. Currently, baby and toddler are Indonesia's biggest market of functional food for baby food or milk. Another functional food market segment prospective to be penetrated is the elderly who have high risk of disease, such as hypertension and arthritis. Players who enter this industry must have strong financial and research capacities. Research on functional compounds in local Indonesian food has been conducted in the preliminary stage and they need to be proven with animal and human studies. Regulation about labelling and advertisement of processed food with special claim and processed food for special nutrition needs is already sufficient to ensure food safety. However, regulation enforcement is still weak.



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## A. BACKGROUND

All countries have made the effort to enhance health and life expectancy since the early 21st century (Vicentini, Liberatore, & Mastrocola, 2016). As their income level increases, society puts more concern on healthy lifestyle, including their food. Furthermore, the national issue of aging population in several developed countries, especially Japan, has driven the market convergence between food and drugs (Bröring, 2013). People now aware that food is not only to satisfy hunger and to fulfill nutrient needs, but also to prevent diseases and to enhance one's physical and mental well-being (Suter, 2013; Bigliardi & Galati, 2013).The rising cost of healthcare, the constant growth in life expectancy, and the concern of enhancing life quality (Siró, Kápolna, Kápolna, & Lugasi, 2008) have created a new hybrid market segment between foods and pharmaceuticals.

This new segmented market has opened innovation opportunities for food industry (Bröring, 2013). Moreover, changes in the environments of food industry and a shrinking food production base have forced food industry to seek for different prospects (Schiefer & Deiters, 2016). Food industry itself had been considered as an industry with low-intensity research and low R&D-to-sale ratio. However, the advancement of biotechnology and genomics had generated a new technology platform for food industry (Bröring, 2010). Technology innovation and the changing preference of food consumers have driven the industry convergence of foods and pharmaceutials to become a new interindustry: functional food industry (Bröring, 2013), where the food processing involves a new scientific and technical approach (Bigliardi & Galati, 2013). This industry offers a new variety of product, ranging from the modest enhancement of food with functional ingredients to the more complex and customized one.

The development of functional food very much depends on innovation at company and industry level. Innovation is needed to develop new functional food products that are new to the market; a product that is not new to the market, but contains functional ingredients for health benefit, or involves new production processes (Villaño, Gironés-Vilapana, García-Viguera, & Moreno, 2016). Companies also need to watch closely the consumer preferences and changing lifestyles as functional food customers come from a niche market. At national level, the development of functional food is shaped by the legal framework. This new product category must be defined clearly and the claim of health benefits must be regulated strictly. In order to address food industry challenges, the consortia between university/research institution and food industry must be facilitated to encourage innovation in food technology (Villaño, Gironés-Vilapana, García-Viguera, & Moreno, 2016).

Functional food product is not new for Indonesia. The most popular functional food in Indonesia, such as formula baby milk and fortified/functioned baby food (Euromonitor International, 2018) has been consumed for decades. The growing supply of other functional food, such as gum candy, healthy cereal, healthy noodles, healthy beverages, etc. can be seen from the displayed local functional food products at most supermarkets and drugstores. However, the development of functional food has just recently caught the attention of the government, following the issue of Rp9 trillion budget deficit experienced by Indonesia's Health & Social Security Agency (BPJS) in 2018 (Hariyadi, 2018). In order to reduce public health cost in the long-term, the government decided to put functional food development as a key strategy. However, the plan to develop a functional food industry is yet to be considered by the Ministry of Industry.

There have been many studies of functional ingredients and the technique to process them to become edible (Astawan & Febrinda, 2010; Astawan, Wresdiyati, Widowati, Bintari, & Ichsani, 2013; Suter, 2013; Nuraida, 2015). However, studies of the functional food industry and its development in Indonesia has not happened. This paper aims to provide the overview of functional food industry in Indonesia, as a result of the industry convergence between food and pharmaceutical industries.

## B. LITERATURE REVIEW

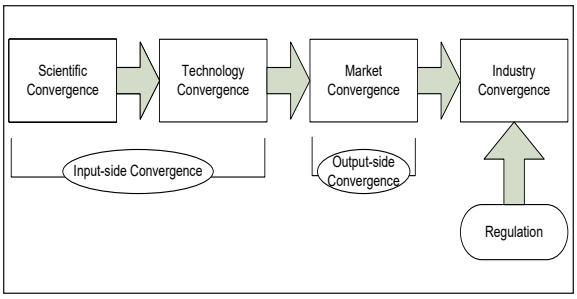
### *1. Industry Convergence*

Convergence means the blurring of boundaries between two or more different areas or fields of science (knowledge), technology, market, and industry. Industry convergence is defined by OECD as "the blurring of technical and regulatory boundaries between sectors of the economy" which were "previously distinct industries" (Choi & Valikangas, 2001). Those dissimilar industries exploit the same knowledge or technologies to produce products and services, and in the same market, they can have either a substitution or complementary relation (Heo & Lee, 2019). Previous studies of industrial convergence talked mainly about the convergence between computer, electronics, and communication industries, while foods and pharmaceutical industries are yet unexplored (Bröring, 2013).

Industry convergence will likely to happen if scientific convergence, technology convergence, and market convergence occur first. Scientific convergence takes place when scientists from different disciplines start to refer each other and work together, while technology convergence exists when science can be applied for technology development (Curran, Bröring, & Leker, 2010). The application of new technology in two distinct industies or the combination of existing technologies from different industries will lead to technology convergence (Bröring, 2013).

As input-side convergence, new knowledge and technological development can lead a company to create new or developed products. Science advancement in the area of biotechnology and genomics has prompted the convergence of food and pharmaceutical industries (Bröring, 2010). The development of bioactive or drug ingredients for enhanced food is triggered by the evolution of biotechnology (Bröring, 2013). Furthermore, the combination of genomics, crop science, genetic engineering, and contemporary medicine has led the development of personalized functional food to prevent and treat diseases (Zhang et al., 2010), in Bröring, 2013).

Technology convergence is then followed by market convergence (output-side convergence), which is driven by demand structure convergence or product substitution from another industry.




Source: Curran, Bröring, and Leker (2010); Bröring (2013)

**Figure 1.** Drivers of Industry Convergence

Increasing consumers' awareness in health and disease prevention (Bigliardi & Galati, 2013; Suter, 2013), rising healthcare cost (Siró, Kápolna, Kápolna, & Lugasi, 2008), aging population and willingness to pay for health benefit (Bröring, 2013) have created new markets as a fusion of food and pharmaceutical consumers. Technology convergence either boosts market convergence when newly introduced product meets the demand; or reduces the process of industry convergence when demand does not respond well to the new product.

Aside from technology-driven input-side convergence and market-driven output-side convergence, regulation is one driver of industry convergence. Regulation can be a driver or a result of industry convergence (Bröring, 2013). Regulation convergence can be driven by the requirement of new industry standards and the need of regulation for the new sector (Bröring, 2010). As a newly formed industry, the functional food industry lacks regulation, even the definition of functional food is still not clear in some countries. However, ex ante analysis on newly introduced product, especially food product, is highly required regarding product safety.

**Figure 1** sums up the drivers of industry convergence. It implies that industry convergence will fully happen if it is driven by both input-side (science and technology) and output-side (market) convergence (Curran, Bröring, & Leker, 2010). Furthermore, regulation also plays a role in creating conducive environment for distinct industries to converge.

### *2. Definition of Functional Food*

The terminology of "functional food" first emerged in Japan after the Ministry of Education, Science, and Culture sponsored two national

research projects. The first one was *Systematic Analysis and Development of Food Functionalities* in 1984–1987 and followed by the second project *Analysis of Body-modulating Functions of Foods* in 1998–1991 (Arai, Yasuoka, & Abe, 2008).The Japanese studied "the relationships between nutrition, sensory satisfaction, fortification, and modulation of psychological systems in order to define those food products fortified with special constituent that posses advantageous psychological effects" (Bigliardi & Galati, 2013). Besides regular food, Japanese started to categorize "foods for specified health use (FOSHU)" (Shankaranarayana, Deshpande, & Bhattacharya, 2013). Besides regular food, Japanese started to catego- rize "foods for specified health use (FOSHU)" that refers to "foods containing ingredients with functions for health and officially approved to claim its physiological effects on the human body, intended to be consumed for the maintenance/promotion of health or special health uses by people who wish to control health conditions, including blood pressure or blood cholesterol" (Shankaranarayana, Deshpande, & Bhattacharya, 2013). Therefore, besides basic nutrition, functional food also provides health benefits (Ghosh, Bagchi, Das, & Smarta, 2013). Since 1991, food in this category must be approved in terms of safety and effectiveness by Ministry of Health, Labor, and Welfare. In 1993, the first FOSHU product was approved in the form of hypoallergic rice grains that can reduce the risk of atopic dermatitis.

As people shifted their view on food from the traditional paradigm (food as a means of providing normal growth and development) to the new self-care paradigm (Clydesdale, 1998, in Institute of Food Technologists, 2005), is also valued food as health benefits provider and co-exist with traditional medical approaches to disease treatment (Institute of Food Technologists, 2005). The concept of functional food was accepted in US. The legal basis of USA functional food was the 1990 Nutrition Labeling and Education Act (NLEA), the 1994 Dietary Supplement Health and Education Act (DSHEA), and the 1995 Food and Drug Administration Modernization Act (FDAMA) (Hoadley & Rowlands, 2014). In terms of regulation, functional food and dietary supplements are considered the same in USA. The term functional food is rather a food marketing concept. Hence, no regulation in USA defines "functional food". However, the USA IFT panel experts define functional food as food and food components that provide a health benefit beyond basic nutrition (for the intended population).

Compared to the aformentioned countries, European countries were a bit late in developing functional food. In Europe, functional food science was concepted through The European Commission Concerted Action on Functional Food Science in Europe (FUFOSE), which was coordinated by International Life Sciences Insitute) Europe in 1995–1997. This project led to European legislation that stated functional food as a concept, not food category (Bigliardi & Galati, 2013). FUFOSE adds that functional food can reduce the risk of disease, remain in the form of food that the claimed effect can be demonstrated through normal consumption pattern.

Looking at the facts that every country or community has their own concept of functional food, there has not been a standard definition for this term (Vicentini, Liberatore, & Mastrocola, 2016; Bigliardi & Galati, 2013). Bigliardi and Galati (2013) reviewed more than a hundred definitions of functional food and they proposed that there are three components in functional food, e.g. health benefit, nutritional function, and technological progress. In order to deliver the health benefits, the food can be in its natural form or modified by adding or eliminating particular ingredients (Food and Nutrition Board, 1994; Hillian, 1995, in Bigliardi & Galati, 2013).

### *3. Innovation in Functional Food*

According to Ghosh, Bagchi, Das, and Smarta (2013), there are four types of functional food, e.g. 1) a natural food in which one of the components has been naturally present at relatively high concentrations; 2) a food to which a component has been added to provide benefits; (3) a food from which a component has been removed so that the food has less adverse health effects; and 4) a food in which the absorption of one or more components has been increased to prove a beneficial effect. Clearly, the innovation component is most likely presented in the last three

**Table 1.** Approved FOSHU Products

| Specified Health Uses | Principal Ingredients (ingredients exhibiting health functions) |
|---|---|
| Foods to modify gastrointestinal conditions | Oligosaccharides, lactose, bifidobacteria, lactic acid bacteria, dietary fiber 8 ingestible dextrin, polydextrol, guar gum, psyllium seed coat, etc. |
| Foods related to blood cholesterol level | Chitosan, soybean protein, degraded sodium alginate |
| Foods related to blood sugar levels | Indigestible dextrin, wheat albumin, guava tea polyphenol, L-arabiose, etc. |
| Foods related to blood pressure | Lactotripeptide, casein dodecaneptide, tochu leaf glycoside (geniposidic acid), sardine peptide, etc. |
| Foods related to dental hygiene | Paratinose, maltitiose, erythrytol, etc. |
| Cholesterol plus gastrointestinal conditions, triacylglycerol plus cholesterol | Degraded sodium alginate, dietary fiber from psyllium seed husk, etc. |
| Foods related to mineral absorption | Calcium citrated malate, casein phosphopeptide, hem iron, fracuto-oligosaccharide, etc. |
| Foods related to osteogenesis | Soybeen isoflavone, Milk basic protein (MBP), etc. |
| Foods related to triacylglycerol | Middle chain fatty acid, etc. |

Source: Ministry of Health, Labor, and Welfare of Japan (n.d)

types of functional food. In order to enhance its functionality, the modification of food need a long stages of research and development.

Since functional food is different from medicine, it can not deal with all health problems. For example, the health issues approved by FOSHU are gastrointestinal condition, blood cholesterol, blood sugar, blood pressure, dental hygiene, mineral absorption, osteogenesis (bone health), and triacylglycerol (accumulation of body fat) (Table 1). The recommended words for health claims are "maintain", "promote", or "help to reduce", such as to maintain low blood pressure, to promote bone health, and to help reducing body fat.

There are several aspects of functional food that contain or need innovation. First, innovation in ingredients (Huppertz & Patel, 2013; Grover, Kumar, Srivastava, & Batish, 2013; Phang, Fry, & Garg, 2013; Dreher, 2013). There are many examples of functional food ingredients, such as milk protein, probiotics, fatty acids, and polyphenol. Innovation is needed to enhance to efficacy of those ingredients' functionality so they can contribute fo specific health and nutritional benefits. Second, innovation in value addition (Kumar & Prakash, 2013). Functional food has higher value added than conventional food through its bioactive subtances that maintain or promote health. The process of extracting the substance then putting it into the food requires an innovative method. Third, innovation for food safety (Polasa & Sesikeran, 2013). Since functional food is a processed food, surely there is a need for innovation in food-processing and packaging technology that can ensure food safety. Fourth, innovation for food packaging (Galic, 2013). In order to keep the longer shelf life of active ingredients contained in functional food, innovation in packaging technology is required, such as edible film, antimicrobial packaging, biodegradable and bio-based material, and nanocomposite packaging.

## C. SCOPE OF THE STUDY

In Indonesia, food technologists and healthy food enthusiasts are already familiar with the term of functional food, but it is not the case for the rest of the society. "Healthy food" or "natural food" are more common to be used. However, the philosophy of food as health benefit provider is not a new thing in Indonesia. Our ancients believed that food can also contribute to health and that knowledge has been inherited for generations. This led to various recipes of traditional herbal medicine – Indonesian used to call it "jamu", i.e. ginger drink for reducing pain and nausea, turmeric and tamarind for easing stomach cramp and healthy skin, or betel leaf for promoting oral health. Those traditional medicines may contain functional ingredients, hence they may be considered as functional food in natural form. However in this paper, the types of functional food discussed are the food and beverages to which a component has been added or removed to provide benefits or reduce harms; the food and beverage in which the absorption of one or more components has been increased to prove a beneficial effect. These types of food required long and

intensive research, technological development, and innovation. This study covers the functional food industry, as the convergence of drugs and food indutries, in Indonesia which capture the market, technology, and regulation convergence.

## D. DATA AND METHODS

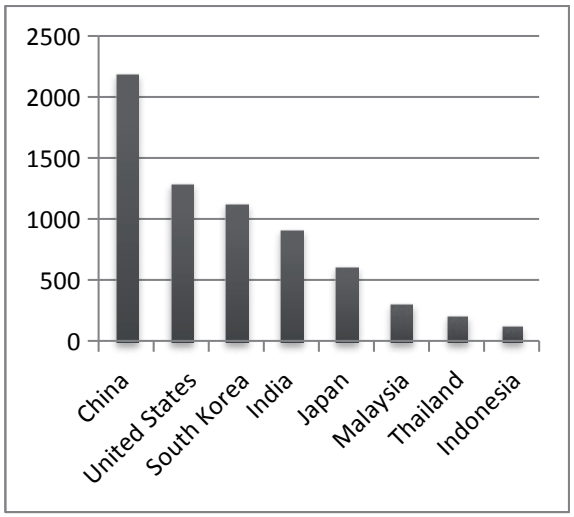
All data for this study was collected from secondary sources. The statistics of publication in the functional food topic was obtained from Scopus website, searched by "functional food" keyword, and limited to Indonesian affiliated authors. The statistics of patent was retrieved from Directorate General of Intellectual Property database, searched by "functional food" keyword, and limited to Indonesian patent owners and Indonesia-based registrants.

## E. RESULTS

Because functional food industry is a result of industry convergence between food and pharmaceutical industries, the overview of results will be based on the industry convergence drivers studies by Curran, Bröring, and Leker (2010) and Bröring (2013). The overview covers scientific aspect, technology aspect, market aspect, and regulation aspect.

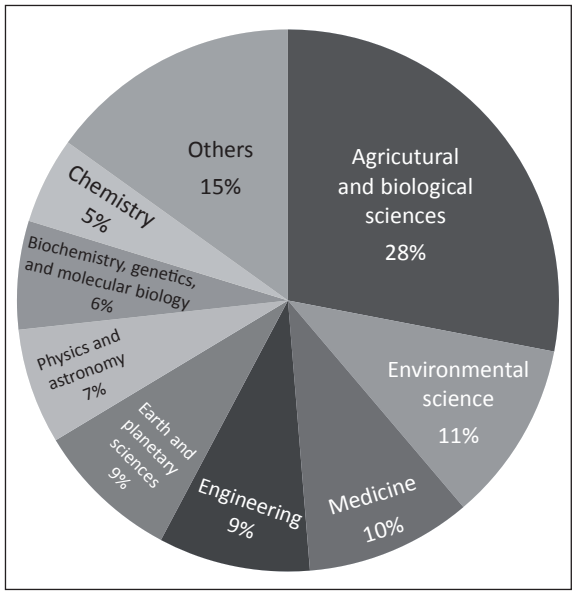
### *1. Scientific Aspect*

Between the period of 2010–2018, 12,568 Scopus-indexed publications regarding functional food have been identified in forms of articles, review, conference papers, book chapters, and books (Figure 2). The top three countries in this field of publications are China (2,193), United States (1,287), and South Korea (1,126). Indonesia is placed 30$^{th}$ with 131 publications, still behind Malaysia (310) and Thailand (211). It shows that the interest of Indonesian scientist on functional food research has emerged, but the quantity is still low compared to other neighboring countries. In 2017, some food technologists, food functional industrialists, and food functional enthusiasts established the Indonesian Society for Functional Food and Nutraceutical (ISFFN), an association dedicated to develop functional food in Indonesia. Since this association is still in its early stage, the activities so far are still in




Source: www.scopus.com (accessed on June 2019)

**Figure 2.** Countries with Number of Scopus-indexed Publication in Functional Food Theme in 2010–2018




Source: www.scopus.com (accessed on June 2019)

**Figure 3.** Subject area of articles in functional food theme published by Indonesian affiliations in 2010–2018

the form of knowledge sharing and networking through meetings and conferences.

The above publications are categorized according to various subject areas. The publications about functional food are mostly included in agricultural and biological sciences (28%), but there are also some articles categorized in the medicine subject (10%). It implies that scientific studies about functional food occurs in food and pharmaceutical subjects.

**Table 2.** Top 5 Functional Food and Beverage Companies in Indonesia by 2017

| Company | Status | Share (% Value) |
|---|---|---|
| *Functional Food* | | |
| Frisian Flag Indonesia PT | MNC | 13.9 |
| Nestle Indonesia PT | MNC | 13.2 |
| SarihusadaGenerasiMahardhika PT | MNC | 8.0 |
| Nutricia Indonesia Sejahtera PT | MNC | 7.0 |
| Kalbe FarmaTbk PT | Local | 6.8 |
| Functional Beverage | | |
| Amerta Indah Otsuka PT | MNC | 19.6 |
| Nestle Indonesia PT | MNC | 16.3 |
| Asia Health Energy Beverages PT | MNC | 10.3 |
| Mayora Indah Tbk PT | Local | 9.5 |
| Danone Aqua PT | MNC | 6.7 |

Source: Euromonitor International (2018)

### *2. Technology Aspect*

The convergence of functional food technology is indicated by patents. Up to the present time, there has been only one granted patent for functional food technology (optimization of *porang* flour cleaning process through maceration method) conducted by one Indonesian unversity. The other 19 requested patents are still in process; only two of them come from industry and the rest come from universities or research centers (Directorate General of Intellectual Property, 2018). This number is not surprising, considering the low output of scientific publications about functional food from Indonesian scientiests.

The technology of functional food is mostly imported from foreign countries through multinational companies who sell functional food products in Indonesia. Table 2 shows the top five companies that lead the sales of functional food and beverage in this country. Only one local company, each in functional food and functional beverage category, were included to the top five.

Multinational companies (MNC) clearly obtained the technology to fortify their food and beverage products from its headquarter companies' R&D. One of the local companies, PT. Kalbe Farma Tbk, has set up its own R&D activities for decades to develop their innovative nutritional food products. For biotechnology research, this company also has formed strategic alliances with international collaborators (PT Kalbe Farma Tbk, 2019).

### *3. Market Aspect*

Indonesia has not suffered an aging population problem yet, compared with Japan. However, if we look at the demographic trend, the problem will likely to occur in several decades. As Indonesian life expectancy keeps growing year by year, the proportion of elderly (people age 60 year-old and higher) will also increase (Figure 4 and Figure 5). Indonesian life expectancy in 2016 is 70.9, up from 69.8 in 2010. The projected life expectancy in 2035 is 72.4. While the proportion of elderly had reached 7.6% in 2010, the percentage is projected to increase to 10% in 2020 and 16% in 2035. The projected percentage in 2035 is still half of current percentage of Japanese aging population that has reached 33%.

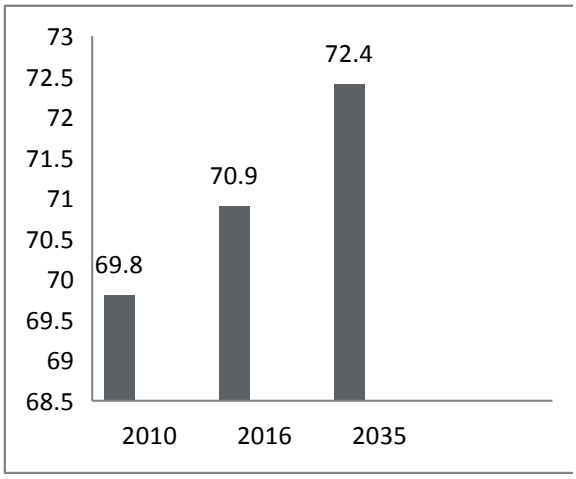
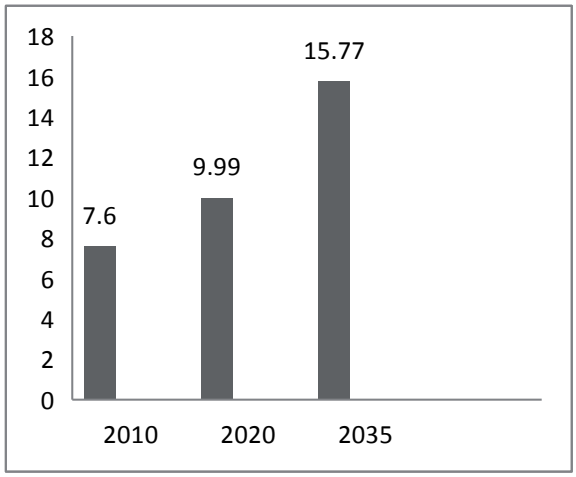



**Figure 4.** Indonesian Life Expectancy




Source: Ministry of Health (2017)

**Figure 5.** Elderly (≥60) Population Percentage in Indonesia

Aging population is usually followed by health problems. According to The Basic Health Research 2013 (Ministry of Health, 2017), the top six diseases suffered by Indonesian elderly are hypertension, arthritis, stroke, dental and oral problem, obstructive lung disease, and diabetes mellitus.

Rather than aging population, Indonesia has bigger issue regarding a young population. As per 2016, there were still 3.4% of babies and toddlers with malnutrition and 14.4% with poor nutrition (Figure 6 and Figure 7). In a year after, the proportion of babies and toddlers with malnutrition increased by 0.4% while the proportion of babies and toddlers with poor nutrition decreased by 0.4%. Malnutrition issue leads to stunting problem. There were 8.6% toddlers in severely stunted status and 19% in stunted status in 2016. While in 2017, the proportion rose to 9.8% of severely stunted toddlers and to 19.8% of stunted toddlers. These statistics show that malnutrition and stunting are still serious problem in this country.

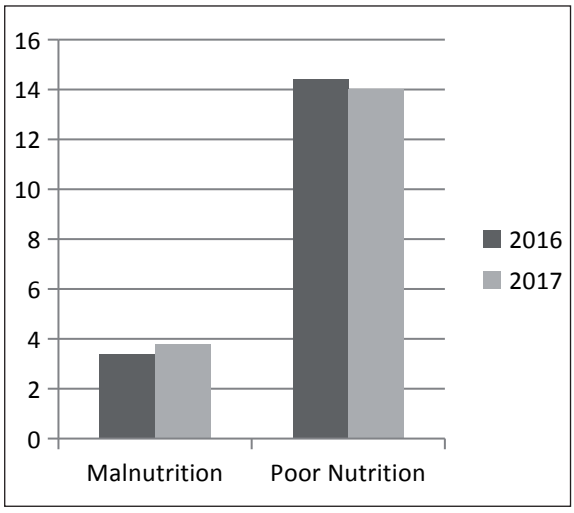
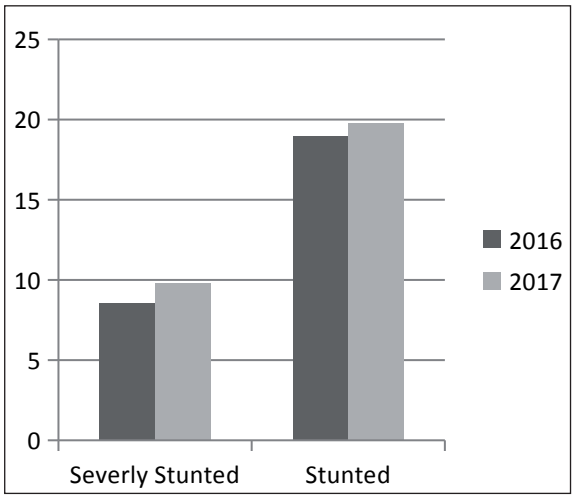



**Figure 6.** Toddlers' Nutrition Status



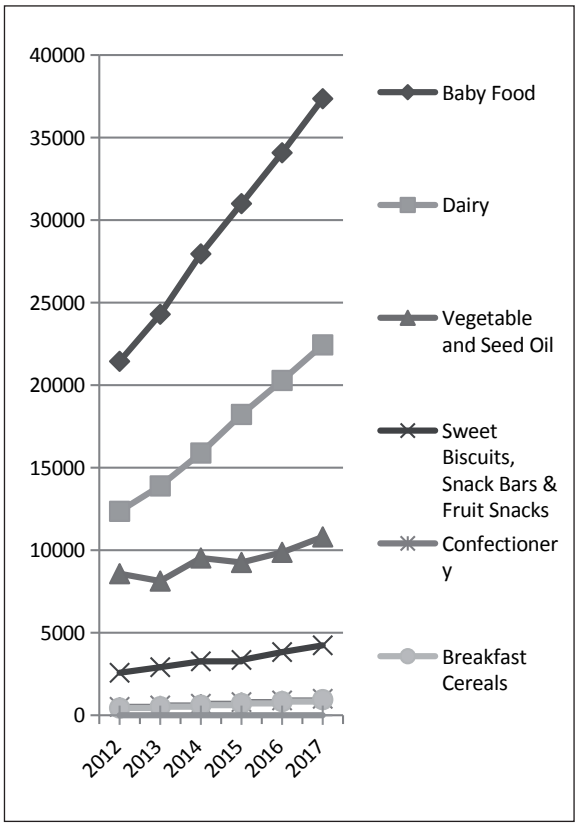

Source: Ministry of Health (2018)

**Figure 7.** Toddlers' Stunting Status

Indonesian demographic statistics show that baby and toddler were likely the biggest potential market for functional food industry in Indonesia. This argument is also supported by Euromonitor International's reports in 2018 that baby food has been leading the market share of functional food in Indonesia (Figure 8). It indicates that among all functional food products, the demand of baby food is the highest. The sales of baby food in 2017 was Rp37,355 billion, followed by dairy (Rp 22,440 billion), and vegetable and seed oil (Rp 10,805 billion). Dairy includes milk, powder milk, flavoured milk drink, dairy-based yoghurt, cheese, margarine, and spreads.

*Regulation Aspect*

Functional food in Indonesia is very much regulated by the National Agency of Drug & Food




Source: Euromonitor International (2018)

**Figure 8.** Sales of Functional Food in Indonesia

Control (Badan Pengawas Obat dan Makanan, NADFC/BPOM). It is different from Japan's FOSHU that has to deal with Ministry of Health, Labor, and Welfare, Council on Pharmaceutical Affairs and Food Sanitation, and Food Safety Commission. The term "functional food" was once mentioned in government regulation by NADFC in Head of NADFC Regulation Number HK.00.05.52.0685 about Basic Provisions of Functional Food Supervision, issued on January 27, 2005. In this regulation, functional food is defined as a processed food, safe for consumption, that contains one or more bioactives with a specific physiological function and proven to have health benefits beyond the basic function of food ingredients and supported by scientific assessment. There are fifteen groups of ingredients approved as functional substances, such as vitamins, minerals, sugar alcohol, unsaturated fatty acid, peptide and protein, amino acid, dietary fiber, prebiotic, probiotic, choline, lecithin and inositol, carnitine and squalene, isoflavones, phytosterols and phytostanols, tea polyphenol, and others.

In 2011, the term functional food was removed through the revocation of Regulation Number HK.00.05.52.0685. Similar to USA, Indonesian government regulation does not explicitly separate functional food from conventional ones. Functional food industry is not found as a separate sector in Ministry of Industry. Functional food then considered as "processed food with special claim" which is now regulated by Head of NADFC Regulation Number 13 Year 2016 about Supervision of Claims on Label and Advertisement of Processed Food. The claim includes nutrition claim, health claim, and other claims not included in nutrition and health claim. According to Article Number 20, the claims must:

a. support national nutrition and/or health policy
b. not be related to disease treatment and prevention
c. not encourage improper consumption pattern
d. be based on total diet, and
e. be accurate and not misleading.

Another food category also includes functional food, that is processed food for special nutrition needs, regulated in Head of NADFC Regulation Number 1 Year 2018 about Supervision for Processed Food for Special Nutrition Needs. This category is divided into processed food for special diet, (e.g. baby formula milk, baby food, milk for pregnant and breastfeeding woman, milk for athlete, and milk for weight control) and for special medical needs (i.e. nutrition support for toddler with malnutrition and stunting problem, food for diabetic/chronic kidney/chronic liver patient, food for patient with inborn errors of metabolism, etc.). The regulation of the former category is not much different from processed food with special claim. The distribution and the use of latter category are regulated more strictly than the former since the food is consumed by patient with disease. The consumption must be under doctor or health expert's recommendation and supervision.

## F. DISCUSSION

The path toward industry convergence has to go through scientific convergence, technology convergence, and market convergence. The development of functional food industry in Indonesia is thus seen from those three above-mentioned aspects.

Since Indonesia is not the pioneer of functional food, many scientific publications about this topic come from other countries, mostly China, USA, and Japan. Publication from Indonesia was only 6% of China's publications. This is an irony because Indonesia is abundant of natural resources which contain big potential of functional ingredients. For Indonesian food and drug scientiest, there are so much room to explore functional ingredients and the technology itself. Unfortunately, research on functional ingredients from Indonesian original functional ingredients are mostly in prelimenary stage and the affect have not studied on animals and humans. This is also the reason of functional food products produced by large and medium enterprises rarely come from Indonesian traditional heritage.

The stagnation of food functional research results in the weak progress of technology development for this industry. Biotechnology, especially genomics, is the core technology of functional food development. This kind of tech-

nology is still in the infancy stage in Indonesia. Thus, functional food industry is dominated by MNC companies, which had already obtained the technology from their head companies.

Only a few local companies dedicate their food product for promoting consumer's health, such as Kalbe Nutritionals and Nutrifood. Larger number of companies also produce conventional food to achieve bigger sales for bigger market, e.g. Mayora Indah and Simba Indosnack Makmur. Most of the companies are the old players in Indonesian food industry and multinational companies still lead the national sales.

As mentioned in the previous section, functional food production requires more resources than conventional production. The cost of research, development, processing techniques, packaging, and marketing may boost the price higher than non-functional food. However, the companies need to think to what extent consumers will be willing to pay higher price of health-promoting food (Apong, 2013). Therefore, functional food is not for every food industry company. Only companies, which have reached economies of scale, will dare to produce food with scientific-proven health benefit claim.

Large number of Indonesian small-medium enterprises (SMEs) may produce natural functional food or processed food made by functional ingredient, usually in form of herbal medicine. Although their products contain functional ingredients (e.g. oranges that naturally contains high vitamin C), they are not allowed to state the health claim unless their products were tested scientifically (which required unaffordable cost). Degradation of functional substances is also suspected to happen without expert supervision in the production process. Those SMEs mainly produce traditional food as resources of functional ingredients, such as ginger, cajuputi, soybean, and many more.

Because functional food has different characters from conventional food, the market is also different. The very distinctive character of functional food is its ability to promote health which requires research and technological process. This led to two things, 1) functional food tends to attract consumers with health problem or who require additional health benefit, e.g. baby and elderly, and 2) functional food is more expensive than ordinary food due to its higher production cost, so it is suitable for the middle-high income consumer. Euromonitor International (2018) also reports that for other functional food products, such as sweet biscuits, snack bars, fruit snacks, confectionary (chocholate, chewing gum, and sugar confectionary), breakfast cereals, and bread, Indonesians are still sensitive to the price and they do not find the necessity to consume those kind of food.

Although the regulation for functional food in Indonesia is not as settled as in Japan, the critical point of functional product—labelling—is already covered in the current NADFC regulation. However, the tough part of this regulation is in the implementation stage. There are still many food products, mostly produced by SMEs, that do not mention health claim on their packaging label, but lists health benefit on their advertisement. Big banner capturing healthy food with unrealistic ten claims on disease treatement or prevention or instant weight loss and smooth skin is a common view found at Indonesian traditional market or small shops. NADFC frequently inspect and confiscate food or herbal medicine producers who do not obey the labelling and advertisement regulation, but they are just like the Greek mythology's Hydra, which grew two new heads every time one head was cut off.

## G. CONCLUSIONS

As a high populated country with rich natural resources, Indonesia is suitable place to develop functional food industry. Currently, baby and toddler are Indonesia's biggest market of functional food for baby formula milk and baby food. Since multinational companies still dominate the market for baby milk and food, competition for local companies will be challenging. Another functional food market segment prospective to be penetrated is the elderly who have higher risk of disease, such as hypertension and arthritis. Healthy food that can maintain low blood pressure and promote bone health is suitable for these consumers.

Extra cost, technology, and human resource capacity are the barriers to entry of functional food industry compared to non-functional one. Therefore, players who enter this industry must have strong financial and research capacities. Currently, this industry is still dominated by MNCs, only a few local companies that had a large size become players in the industry. SMEs are unlikely the right actors for the development of this industry. Research about functional compounds in local Indonesian food, such as tempeh, husk, and *tapai*, have already conducted in preliminary stage and they need to be proven on animal and human studies. The strategy of industry and academia collaboration must be managed in order to enhance private fund research.

Regulation about labelling and advertisement of processed food with special claim and processed food for special nutrition needs is already sufficient to ensure food safety. However, law enforcement is still weak. NADFC might have to coordinate with Ministry of Health, Ministry of Trade, and Police Department to abolish ilegal advertisement and the distribution of food with false health claim.

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