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Plant Biodiversity-based Research, Innovation and Business Opportunities

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Abstract

Malaysia is rich with different type of plant and herb. In our plant biodiversity-based research and innovation, we focus on demand-based biotechnology development as well as nurturing academic inventions by bridging biotechnology and market applications to benefit communities at large. As an outcome of our first phase of research project, we have focused on identifying biotechnology research, primarily in UKM, that has potential in biobusiness, which may benefit from the research and business development support. Primary and secondary data have been collected and analysed from the masses of research reported in UKM and we have narrowed down on Cilibangi (*Capsicum annuum*), Roselle (*Hibiscus sabdariffa*), Kesum (*Polygonum minus*), Serai Wangi (*Cymbopogon citratus*), Red Rice (*Oryza rufipogon*), Serai Pedas (*Backhousia citriodora*), Kacangma (*Leonurus sibiricus*), and System of Rice Intensification (SRI) organic rice planting system. In the current market, there is a trend towards healthy lifestyle and demanding more on healthy food and beverages. Towards this end, plant-based and organic products are increasingly attracting producer and consumer attention. The growth of this consumption trend provides marketing opportunity of value-added food and beverages produced from plants or herbs. In addition, the international, regional and local market of plant-based food, beverages, jellies and confectionaries are also readily available. Therefore, research and innovation in plant biodiversity is timely and provide substantial value to consumers, producers as well as entrepreneurs.

Keywords: biobusiness, biotechnology, innovation, market application

1. Introduction

Plants have been source of food and medicinal purposes for many centuries. Today, plants and herbs are being employed worldwide in a variety of health care settings and as home remedies. In developing countries like Malaysia, communities rely heavily on traditional health practitioners and medicinal plants to meet their health care needs. Malaysia has approximately 15,000 known plant species, whereby only a mere fraction of 3,700 species is identified of their usage whereas the rest remains unexplored (Adenan 2003). Most of these plants including aquatic and semi aquatic species are believed to harbour bioactive potential diversity. These vast untapped biological resources can be further explored, developed and marketed as special natural products (DOA, Malaysia).

In many industrialized countries, plant-based products are gaining popularity as alternative remedies and for healthy living. This has led to increasing interest in plants especially herbs; and its escalating utilisation and commercialisation worldwide. At present, plants as a whole or extracts are widely used in making beverages, to flavour food, ingredients in cosmetic and pharmaceutical products, health supplements and insect repellent. Clinical interest in the flavonoid compounds found in plants that demonstrated anticancer, anti-inflammatory, anti-diabetic, antioxidant and anti-bacteria, amongst others are given in depth study (Ballick 1990). Much scientific study were undertaken to ascertain the nutritional and pharmaceutical values of plants in order to establish their market potential value. All these are to ensure the vast potential of natural plant resources are wholly capitalised for the benefit of humankind (Vallance & Smart 2006).

Since products based on plant and herbs is gaining wide interest worldwide; Malaysia blessed with such richness and diversity of natural flora should push forward the identification, research and development, along side with management and marketing of such products. Towards this end, close collaboration between research and marketing to increase the competitiveness of plant-based product is crucial to integrate the entire necessary component from both fields of science and commercialising aspects. On this note, this paper reports on selected innovative research based on plants in Universiti Kebangsaan Malaysia (UKM), focusing on their potential value from the marketing aspects and explore their opportunities to meet market demand-based biotechnology development.

Our approach was to screen through the masses of plant-based research reported in UKM, ascertain their innovation and then proceed with market analysis of data collected. In this process, we encompassed biological analysis of the scientific data collected. From the analysis, a product was defined, and in certain cases after getting feedback from pilot test results to be applied in research and developed further. Finally, market analysis pertaining to the product was undertaken to gauge its business opportunity (Fig. 1).

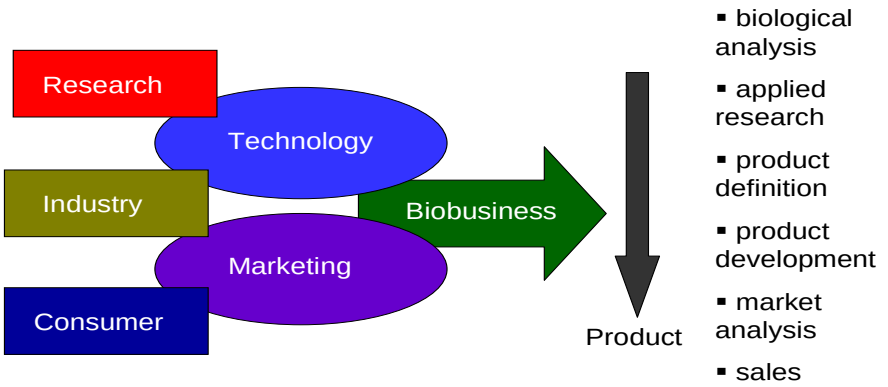

Figure 1: Schematic diagram representing intergrative steps involved from initial research to the final consumer product

2. Methodology

The project is conceptualized in three different phases (Fig. 2), whereby each phases contained an objective and targeted milestones. The first phase of 'Marketing Research' was carried out through stages as follows:

I. Data collection on biotechnology research in UKM database
   a. Centre for Collaborative Innovation (PIK)
   b. Centre for Research and Innovation Management (CRIM)
   c. UKM Holdings (www.ukmholdings.ukm.my)
   d. UKM-Tech (www.ukmtech.com)

e. Faculty of Science and Technology (FST)

II. Identifying potentially demanded research products related to biotechnology
III. Conduct marketing research for identified product concept
IV. Develop marketing plan for feasible biotechnology products

Phase 1 (2012-2014) Marketing Research	**Phase 2 (2015-2016)** Technology and Psychological Capital	**Phase 3 (2017-2018)** Developing Business Database & Product Portfolio
▪ Environmental Scanning ▪ Biotechnology Products- Demand Identification ▪ Market and Product Analysis ▪ Bio-Business Development Framework	▪ Locating Technological Capital ▪ Locating Human Capital	▪ Biotechnology Business Database ▪ Demand-based Biotechnology Product Portfolio

Figure 2: Outline of the project concept, objective and targeted output

3. Results and Discussion

Data on reported research were collected from UKM, and analysed as shown in Fig. 3. Agro-based and food product constituted a mere 10%. However, most of the data obtained and analysed were from reported prototype or prototype that has been filed for intellectual property rights. There is still a large number of agro- or plant-based researches that has not been properly documented because they have not been filed or far behind from the stage of being a prototype and thus not included in the analysis.

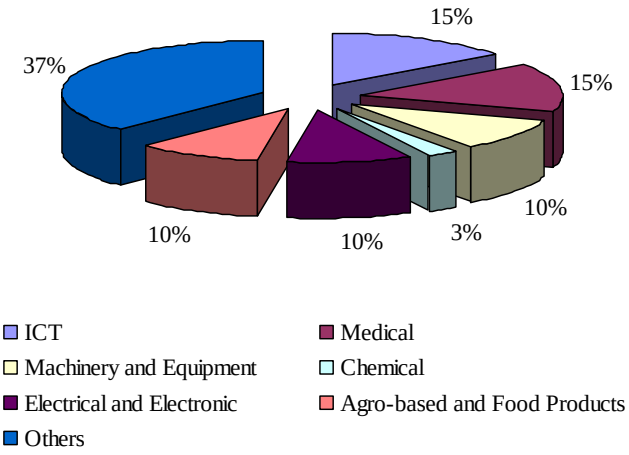

Figure 3: Innovative research reported in UKM based on sectors 2012
Source : Adapted from UKM-Centre for Collaborative Innovation 2013

We have identified eight plant-based biotechnology innovative researches that have potential market development opportunity and can benefit from strategic marketing plan. Table 1 summarises the research and the role of UKM scientific contribution to the research innovation.

Table 1: Innovative plant-based biotechnological research with market opportunities and business potential

Research	UKM	Properties	References
Chilli (*Capsicum annuum*)	Varieties developed Cilibangi 1 Cilibangi 2 Crunchious	• synchronized maturity • upright maturity • hot taste fruits • longer shelf-life fruits • medium fruit size • virus resistance • compact plant	http://www.cilibangi.com/
Roselle (*Hibiscus sabdariffa*)	Varieties developed UKMR-1 UKMR-2 UKMR-3	• higher number of fruit per plant • heavier fruits (g) • higher anthocyanin content (mg/100g dried calyx) • higher hydroxycitric acid content (%) • higher calyx production (tonnes/ hectare)	Mohamad et al. 2008
Kesum (*Polygonum minus*)	Kesum phenolic extract	• antiviral, and anticancer activity and named it *Polygonum minus* C3 (PMC-3) similar to anti-cancer agent vanicoside D	Led by Dr. Syarul Nataqain Baharum http://www.ukm.my/news/index.php/en/component/content/article/66-current-research-news/1091-kesum-may-have-anti-cancer-properties-ukm-study-shows.html
Serai Wangi (*Cymbopogon citratus*)	Aqueous extract	• prevents both the testicular histopathological abnormalities • prevents reduction of sperm viability, motility and count	Rahim et al. 2013
Red Rice (*Oryza rufipogon*)	UKMRC9 (*Oryza rufipogon* X Malaysian rice cultivar MR219)	• Intermediate growth duration (~125 days) • High grain yield (~ 5.5 t/ha) • Blast disease resistant • High percentage of filled rough rice (98.5-99.0%)	Karupaiah et al. 2011

Serai Pedas (*Backhousia citriodora*)	Locally cultivated serai pedas	• higher percentages of geranial (50.01%) and neral (42.85%) compared to the Australian Standard of 44.0% and 32.0%	Hayes & Markovic 2002, 2003
Kacangma (*Leonurus sibiricus*)	Aqueous extract	• Heat stable antimicrobial activities against *Aspergillus niger*, *Saccharomyces cerevisae* and *Staphylococcus aureus*	Chua & Aminah 2011
System of Rice Intensification (SRI) Organic Rice	Agro-ecological approach	• Integrated biodiversity management: managing pests and other macrofauna • Labour saving devices in development. • Higher vitamin B1 and B3 content in cultivated rice	Nur Haqim et al. 2013; Anizan Isahak & Che Radziah Che Md Zin (2012)

According to World Bank report, the market for plant-based product will increase from RM 750 billion in 2008 to RM19 trillion by the year 2050. The global market size for herbs alone in 1996 is approximately USD14 billion, increased to USD200 billion in 2008 and is expected to be USD5 trillion by 2050 (Joerg 1998). Furthermore, in market, there is a trend towards healthy lifestyle and demanding more on healthy beverages. In terms of soft drinks there are ready-to-drink and concentrates products. The growth of this consumption trend provide opportunity of value added beverages produced from herbs such as *Hibiscus sabdiriffa* or roselle drinks (Ramirez et al. 2010). The international, regional and local markets of hot and cold beverages, jellies, confectionaries are also ready available (Obadina & Oyewole 2007; Ramirez et al. 2010; Sayago-Ayerdi et al. 2007). In Malaysia alone, the market for plant-based products is estimated at RM4.55 billion, with a rapid growth rate of 15-20% annually. The market size in 2000 is around RM2 billion and the local raw materials contributed to less than 5%, amounting to RM 100 million. For Malaysia to compete globally, the contribution of local plant-based product should increase to 48% in 2010, in which Malaysia is still lagging behind (Puteh 1999).

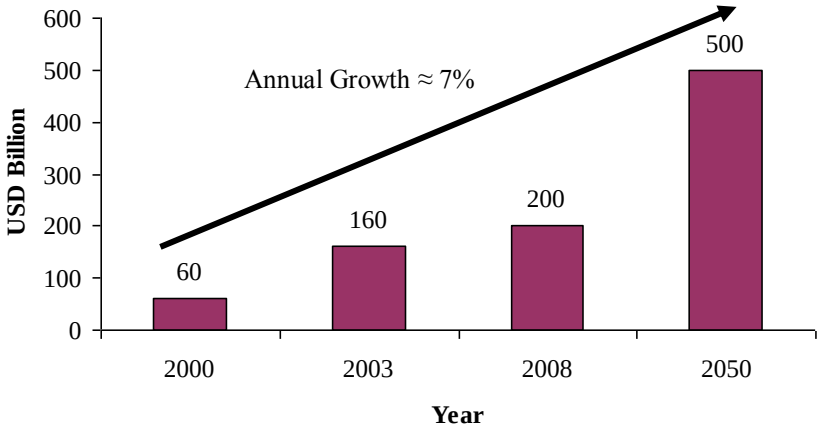

Figure 4: Global market value of herbal industry and the estimated growth
Source : World Bank

In Malaysia, under the Third National Agriculture Policy, (1998-2010) plants and herbs are specifically highlighted as special product to be further developed into industries. This is reflected by the huge investment on R&D sector and the commercialising aspects of plant-based industries, including the East Coast Economic Region (ECER) and the Sabah Agro-Industrial Precinct (SAIP). Under these projects, various industries orientates towards different stages of plant production were undertaken, which include farming and harvesting and related technology, essential oil extracting, processing, R&D, packaging, biotechnology in improving the seeds and cultivar. Amongst the various herbs and plants, Department of Agriculture, Malaysia has identified roselle, lemongrass, chilli, and kesum that are competitive commercially and that have huge business potential (Fig. 4). Although lemon myrtle is not in the list, but judging from the high demands from Australia alone, the development of lemon myrtle farm can be of great prospect too.

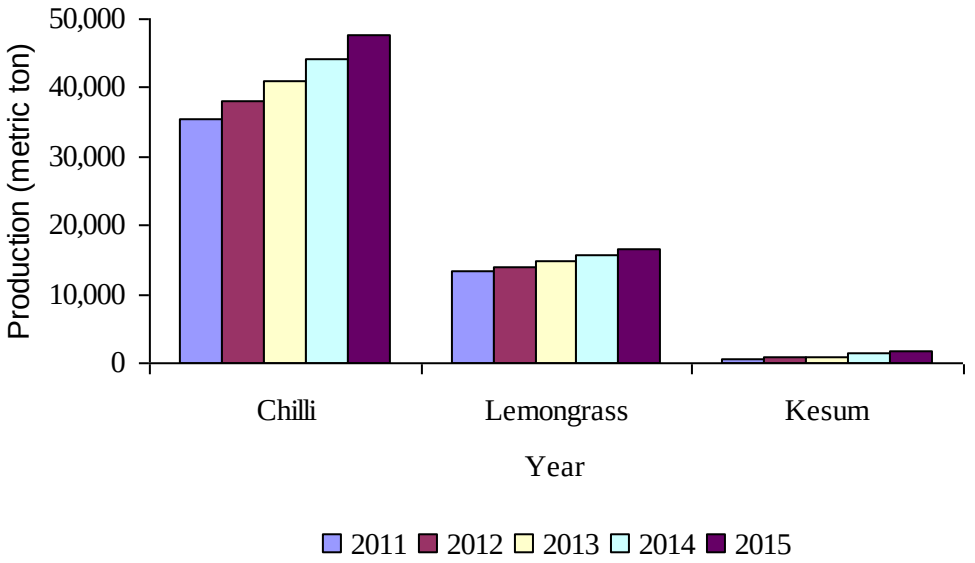

Figure 4: Targeted production of chilli, lemongrass and kesum from 2011 to 2015
Source: Department of Agriculture, Malaysia

5. Conclusion

The plant biodiversity-based research and innovation is important and matching the market trend towards healthy living and sustainable agricultural biotechnology. In this aspect close collaboration and integration between academic research, business application and marketing effort would benefit various stakeholders including communities, producers, channel members and end consumers. UKM with the various innovative researches is well positioned to contribute to the growth and competitiveness of plant-based business opportunities in Malaysia. This paper only briefly communicates some agricultural biotechnology researches or collaborative researches which are selected at our early stage of exploratory study on agricultural biotechnology business opportunities.

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