

REVIEW ARTICLE

AN OVERVIEW OF RESEARCH AND INDUSTRY CONNECTIVITY FOR EBN

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ABSTRACT. As of 2016, a total of 38 research projects have been undertaken, with the involvement of 38 principal researchers and 266 co-researchers from various Malaysian universities, research institutes and government agencies, in collaboration with industry partners, to help solve some of the issues faced by EBN industry. In the early stage, research areas were focused on fundamental works which are important to provide the scientific basis for some of the claims made by producers, assisting in issues raised by ranchers and industry, and to gather new knowledge in swiftlet and EBN. The researchers worked mainly based on the problems faced by the industry. Besides publications in journals, proceedings and books, more than 30 Masters, PhDs and technical experts have been trained under these projects. In addition, several patents have been filed, social innovations and ideas have been shared with the community and industry. A few products are ready to go to the next level for commercialisation. Industry partners are involved in many of these steps and outputs. Some of the issues faced by the industry have been partially solved and are in the process of refinement. The engagement with the industry will be further strengthened by getting more industry

partners to be involved in the relevant projects specific to problems faced by the industry, for the benefits of EBN industry and nation's wealth creation.

Keywords: swiftlet, EBN, Walit

INTRODUCTION

The Centre of Excellence for Swiftlet (COE) was established in 2011 with special reference to coordinate research and development (R&D) in relation to swiftlet and edible bird nest (EBN). The Universiti Putra Malaysia was given a mandate as national COE for Swiftlet to coordinate R&D activities for swiftlet and EBN to ensure the sustainability and competitiveness of the industry. To carry out the responsibilities as National COE for swiftlet, the Centre has no physical infrastructure such as buildings or laboratories or office to execute its activities. The Centre received many requests from the industry player and other related agencies to visit these facilities where research is carried out. However, the Centre involves many agencies and research institution such as MARDI, SIRIM, universities (public and private) where facilities were utilised; while DVS and UPM were the main coordinators of all the activities. Research activities

are decentralised all over Malaysia where the researchers are available; therefore, facilities of the Centre can be found actively performing research in the major facilities extensively. Thus, it is within the agencies, universities as well as the industry itself. As leading agencies, UPM and DVS are responsible to coordinate and monitor all research activities which should be in line with the industry needs.

Based on the mandate from the funding agency (MOA), the Centre is working on the issues related to the industry needs. There are many ways to understand the need of the industry in order to ensure the industry will be sustainable and competitive globally. A series of meetings and workshops have been conducted with related agencies, industry players and other stakeholders to identify the issues and problems plaguing the industry. After in depth discussions with all stakeholders and recognising the lack of scientific evidence on Swiftlet and EBN itself, it was very important for the Centre to work more on fundamental and basic research. A lot of basic research work needed to be done before research products or finding go in-to the market and this required careful planning on research agenda to elucidate the right information to help project the EBN market internationally. Several programs were identified involving several projects which are needed to solve immediate problems in the industry. However each project will require at least 2 to 3 years of intensive work and research for a sustainable solution.

The main objective of setting up the Centre is to increase the production of EBN and this was stressed under entre point project number 2 (EPP#2). In the

NKEA (National Key Economic Areas), R&D is identified as one of the activities in developing the Swiftlet industry. As the COE for Swiftlet, the Centre has coordinated various research components with regards to Swiftlet and EBN in order to enhance the industry to meet the current global market. Research activities have been funded by the government through the Ministry of Agriculture and Agro-based Industry with the Department of Veterinary Services as a lead agency. Selections of the projects are based on the industry needs and the research team will be invited to present their research proposals to the technical and evaluation committee for those selected projects. The proposal will be sent back to the researcher if any corrections have to be made before endorsement by the committee at the Centre level. The research proposal has to go through various steps of screening process and revision by committees in the Centre as well as by DVS before approval. Most of the research projects at the Centre, although initiated by DVS or UPM, are executed by other research groups and organisations. In addition, during the review process of research proposals, the scientific merits and the capacity building component are ranked high. As of 2016, 38 research projects have been undertaken, with 266 co-researchers, more than 30 Masters and PhD students produced.

Edible-Nest Swiftlets

Swiftlets are swallow-like birds which are able to navigate through dark caves, using echolocation or bio-sonar system as similar to bats (Brinkløv *et al.*, 2013). Their nests are

edible made from the saliva known as Edible Bird's Nest (EBN). EBN is a glutinous secretion from their 2 sublingual salivary glands of swiftlet. It is produced by two main species of swiftlets: (i) *Aerodramus fuciphagus* (white nests) and (ii) *Aerodramus maximus* (black nests). The major nutrient components of EBN are high value glycoproteins (Kathan and Weeks, 1969) rich in amino acids, carbohydrate, calcium, sodium and potassium (Norhayati *et al.*, 2010). However, the swiftlet that can produce EBN can only be found in a few countries in South East Asia. Their habitats are based on the present of arthropods (ants, termites, insects, etc.) as food source.

Edible-nest swiftlet existed naturally 48,000 years ago in caves as their natural dwellings. Now it has become a very important industry due to the high value of EBN and edible-nest swiftlets are now ranched at man-made premises. Malaysia is at the epicenter of EBN producing nations, and the largest EBN processing country in the world. Malaysia is also one of the largest exporters of EBN.

Why EBN Is Highly Valued?

EBN is used traditionally as food delicacy but what is most important is many believe that EBN has health enhancing effect, anti-aging, growth promoting, immune-enhancing properties, lowering risk of disease and promoting life span (O'Hara *et al.*, 1998). However, these are merely just claims made by people historically during the Tang Dynasty; with no solid data and lacking in terms of scientific evidence and verification. There is scanty, non-scientific

information over the past years although EBN has been used widely in China and Indo China. All these claims need to be verified by scientifically so that it can be utilised confidently to propel the industry. More importantly now, safety issues with regards to all EBN products are of utmost importance to give credibility to the producing countries so that buyers and importers are keen to deal with the products.

EBN industry in Malaysia

Malaysia produces around 350 metric tons of EBN annually and in the year 2015 around 105 tons EBN were exported. In 2015, it was estimated that there were more than 50,000 EBN premises throughout the country. However, up to Oct 2016, only 21,000 swiftlet premises and 250 processing plants have been registered with Department of Veterinary Services. EBN industry is considered as high value industry because it can generate higher income to the entrepreneurs.

Main Challenges In EBN Industry In Malaysia

A few challenges have been identified during discussion with industry players in EBN industry including authenticity, high nitrite/nitrate content, over exploitation of EBN and also related to the regulation and policy. Many EBN products in the market are known to have incorporated adulterants to reduce the cost and increase the profit margin. It is a challenging issue to detect the products with adulteration or products with contamination during the processing.

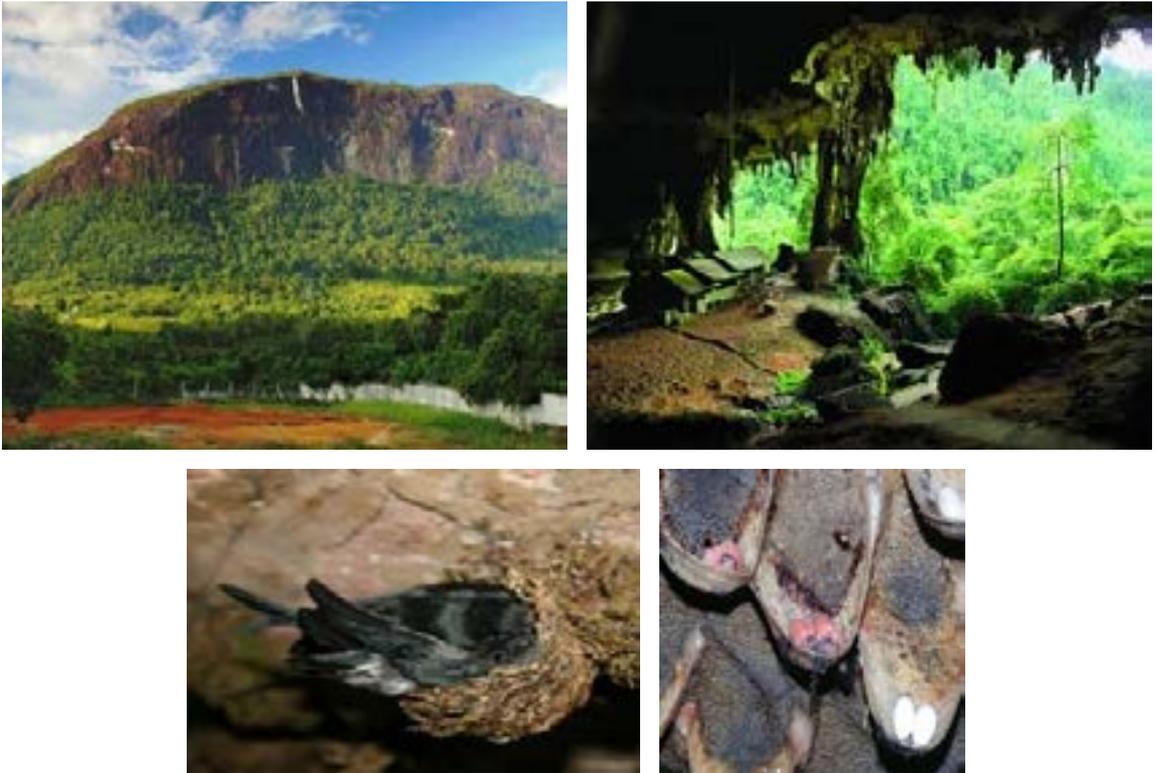


Figure 1. Edible-nest swiftlet existed naturally 48,000 years ago in caves as their natural dwellings (Source: Department of Veterinary Services)



Figure 2. Different examples of types of bird's houses

Another issue that is a priority for the Centre is the high nitrite and nitrate content in EBN. When the CVCA was established in 2011, the China government decided to stop immediately the importation of EBN products. Although some of those issues are related to regulatory or policy matters which is beyond the scope of research, but in terms of identification and quantification of nitrite/nitrate, it needs immediate solutions by the Centre.

Over exploitation of EBN due to depleting swiftlet population, quality assessments of EBN products, sustainability of the industry, export issues as well as market variability also have been studied. These are the critical issues which have been voiced by industry that the Centre should be looking into. Regulatory and policy matters are beyond the research scope, high end products, diversification of products are also important issues. To address all these issues and due to the lack of scientific information, a lot of basic work needs to be done in order to address all the issues that concern the industry.

Selection Of Research Clusters

In order to identify the research areas for EBN Swiftlet industry several meetings and workshops were held with the stakeholders (industry players) and related agencies to identify issues that need attention. Based on all those discussions and response by the industry during workshops and literature surveys by researchers, the committee decided to look into seven research clusters (Figure 3). Those research clusters are Ecology, Genetic, Health, Economics

and Downstream, Marketing, Quality and EBN Production. However, in the case of the critical issues, research groups will be identified to do immediate work and based on further discussions, more research groups will be invited.

Allocation was received toward the end of 2011 and at the same time the Centre was focusing on the issues that the industry needs immediate attention. Therefore, most of the work started only in 2012 and this year is the fifth year of the project under the national COE for Swiftlet. Despite that, within these five years a tremendous amount of work has been done; where by some products have gone for commercialisation, some still in the stage of refinement and a lot more results and products were obtained to resolve issues and problems.

Ecology is one of the most important aspects of research in EBN Swiftlet industry. Various research projects were carried out by the Centre such as looking at the species distribution, the type of species, habitat as well as their feed, feed factors and type of nutrition. The industry needs scientific data, information or the facts to support the claims about their products. Study on feeding for example, bullous from the birds is collected and the content will tell of what kind of insect the birds consume. Sound wave study is very important to reduce sound, plant phenology, aroma, are included under this cluster.

In cluster genetic, research should look into the variability of the various species of the bird. For example, in the real environment there are many birds flying around, but whether they are really swiftlets which producing EBN or other birds that take

the opportunity to go into the houses to seek shelter, is one of the interesting information that is required. Sexing and traceability of the products are also important elements to look into under this cluster.

Under cluster of production, nutrition and structural, researches have been focused on the aspect of nutrition, composition, gastrointestinal tract (GIT) and salivary glands. The anatomy/physiology study has been done on the GIT as well as salivary

glands as the book on the electron microscopy of the salivary glands and GIT was launch during EBNIC 2016. Thus research findings clearly can show and confirm the kind of insects that the bird was consuming (Tengku A.I and Rafiuz Z.H, 2016). The industry players are recommended to read this book because it is very interesting and informative. This is the only book available in the world talking about the ultra-structure of intestine and the salivary glands of the



Figure 3. Research clusters in EBN Swiftlet Industry

bird, as salivary glands of swiftlet is very important component in the production of EBN. The work that has been done by researchers in these areas contributed a lot of new knowledge and a tremendous amount of information as required by industry. As the Centre of Excellence, this is just a first step in research because there are many more scientific evidence regarding the bird under genetic studies. Furthermore this will further give a new vision in R&D work. All this basic research needs to be explored for the benefit to the industry.

In terms of the quality of EBN and EBN products, SIRIM and the Department of Veterinary Services are collaborating in developing new quality standards of EBN produced in Malaysia. Study was focused on the specific criteria of EBN and developing test methods using sensor technology which is detecting a certain content of sialic acid. Researchers are using the immunomodulator approach in order to develop the quality index for EBN produced in Malaysia.

EBN is an important product material for the industry and also for the swiftlet. This is because the swiftlet produces EBN from saliva for their nest and the industry needs it for different purposes. Therefore, it is important that research is not just focusing on EBN alone but must include health status of the swiftlet as well. Study on the bacteriology, virology and parasitology have been done to elucidate the pathogens that would affect the birds. As they are flying most of the time, there may be less likelihood of picking up pathogens unless in contact with other bird species or from the insects. However, while in the houses which are enclosed, there may be pathogens

accumulating and can be a source of infection or contamination. Thus, looking at anti-cancer agent, anti-inflammatory agent and anti-microbial agent may be also one important aspect of study. This is important as there are several claims made by people related to the benefits to human health in consuming EBN. These claims need to be validated scientifically for consumers.

Other research work that has been done and produce some very good results are studies on guano. The uses of guano need to be studied and its benefits in the agriculture industry as fertiliser needs to be cost effective yet profitable.

Economic and downstream products, the food ingredient, health supplement and value added products are also the research areas that have been conducted in the last five years under the Centre. A critical part of research is on marketing; is looking into the economic aspects and economic analysis, where studies are done. Especially so, when there is a reduction in the price of EBN, how will it affect the producer and ultimately the importer and exporters.

Research Project Under COE Swiftlet

A total of 38 research projects have been conducted, with the involvement of 304 researchers and co-researchers from various Malaysian universities, research institutes and government agencies, in collaboration with industry partners. Besides product publications in journals, proceedings and books, more than 30 Masters, PhDs and technical experts have been trained under these projects. Within five years of research activities on EBN and Swiftlet, the Centre

has come up with a tremendous amount of data and information for public and industry players. All scientific information can be excessed in a compilation via a book on scientific results/data generated from the research work under COE.

One of the most important research projects under COE is on the authentication. Analysis has been done on EBN based on Proteomics-Based methods in combination with Chemometrics. The methods can be used now in other avenues to authenticate whether the EBN is real or artificial. Other projects are working on the development of PCR-ELISA methods for rapid and simultaneous identification of EBN and related to the swiftlets species. In terms of quality and anti-aging determinants in EBN, nutrigenomic and metabolomics strategies has been used to collect more scientific data to support the industry. While research on transcriptome profiling in order to identify novel biomarkers in swiftlets conservation is an importance work for susceptibility and sustainability of industry. This work could be of help to the industry in the issue of the decreasing population of the birds. Structural and conformational studies of edible birds' nest proteins, Roosting and Nesting Behavior of White-nest Swiftlets (*Aerodramus fuciphagus*) and the effect of Edible Bird's Nest Extract on Chondrocytes isolated from Osteoarthritic Articular Cartilage are some of the examples of the work done.

Research outputs have recorded tremendous achievements since the last five years. In the guano project, it is not only coming up with products like organic fertilizer and aquatic feed for fish but the

most important findings is the scientific data showing swiftlet guano can be a cheap source of protein in feed for livestock. Research work on the "birds call system" to reduce noisy sound is excellent work to ensure the right bird species are attracted into the house to produce EBN. Software has been developed to yield bird call by shifting high frequency and reducing noisy sound to human hearing. Hopefully, this project can come up with the proper kind of calls to make sure the birds are coming into the house for nesting. In terms of nitrite and nitrate in EBN, there are many ways of identifying and quantifying nitrite and nitrate but the methods available takes longer time and need other facilities or equipment. Research has been done by UniMAP to develop electronic device called E-tongue which can detect nitrite and nitrate within 5 minute. At the same time the groups also develop another electronic device to determine the quality of ambient air in EBN house using the E-nose technique. This is to detect the amount of ammonia present in the house.

The Swiftlet diet study reported the kind or species of insect present in digestive system including the Mayflies, Swarming termite and so on (Figure 4). Base on this information, studies can be conducted to delve deeper by using electron microscopy to study various adaptable traits in these insects that make them preferable for swiftlets. Thus we can identify the surrounding areas with the possibility of locating new source of these insects. This will give us more environmental flexibility when building swiftlet houses in areas where there

could be abundant insect as food source for swiftlet.

The housing aspect is also a very important issue to be resolved if the bird does not come into the house to nest especially after a huge amount of capital cost has been spent by the producers. There can be various reasons for this and involves various factors as to why the bird does not nest in the house. The combination of experiences from consultant and the scientific data will help to resolve those problems including the housing system (lighting, humidity, and the design inside the house). However, it is very important for the industry players to recognise all these criteria's for successful housing as it is based on experiences of existing producers.

EBN downstream products

Development of downstream products from bio-technologically processed EBN has produced new value-added and innovative products from the traditional raw edible swiftlet nests. Food, Functional food, Cosmetics, Health products (e.g. animal studies of EBN: has proven to have anti-inflammatory potential and regular consumption reverse the oxidative damage to the brain – dementia). The Centre realises that research cannot just end with publications or just ended up on the shelf as reports or raw data but needs to go for commercialisation of products or establishment of techniques and methods that can be valuably utilised by all.

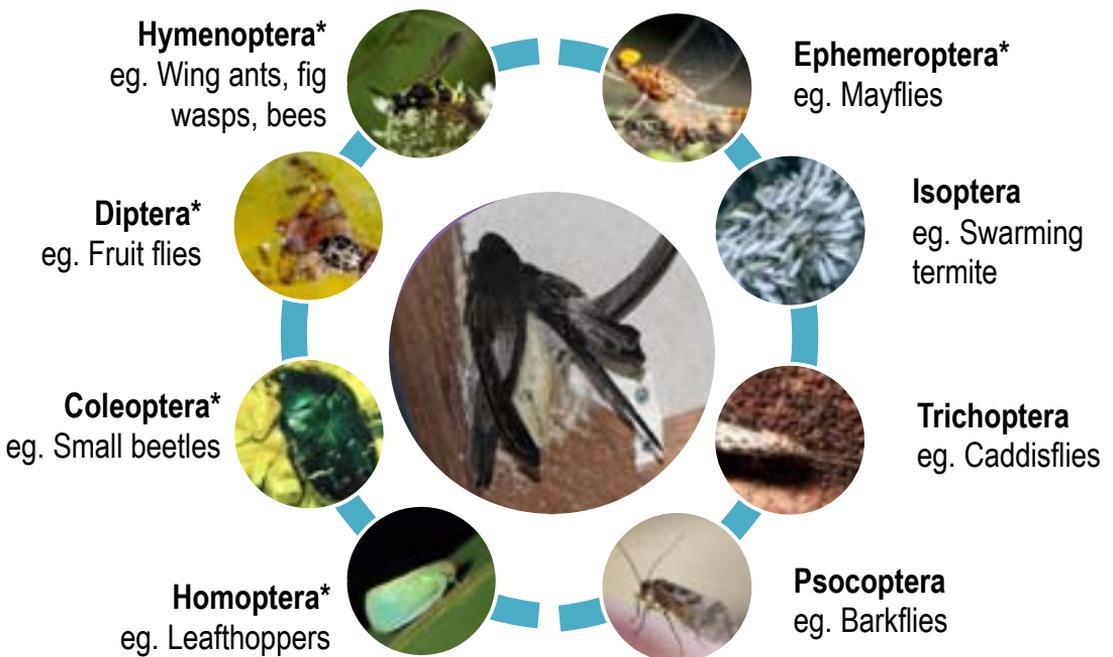


Figure 4. Swiftlet diet (Sharifah et al., 2016)

Consequently, commercialisation is not an easy process because it must commercialise the right products or what is needed by industry and the most importantly it is accepted by market demand. This very much depends on the involvement of industry players who should give feedback at crucial intervals to jump start the products or techniques on its usability, which most of the time can be challenging.

CONCLUSION

Ongoing research in various areas will benefit the industry and has contributed to the economic importance for Malaysia. Many issues related to the industry and government has been addressed especially on the export of the raw nests, product quality, nitrite issues and market surveys by the group of research collaborators from University National Malaysia, University Malaysia Perlis, SIRIM, University Malaysia Kelantan and University Science Malaysia. It is proudly said that the Centre has a very strong group of research collaborators all over Malaysia involved in this program with their own niche of experts and disciplines. The networking and linkages has a very strong relationship with Malaysians together with the support from Department of Veterinary Services to encourage industry needs and outline research programmes. We look forward to seeing more collaborations work and support from the industry.

In conclusion, besides training human resources, capacity building, publications and IPs, a tremendous amount of new knowledge, confirmation of various claims has been done. The R&D that was done is in line with the needs of the industry. Although, a lot more work need to be done but at least at the moment the Centre can provide the industry scientific evidences of the claims on the values of EBN and solving some of the main concerns of swiftlet industry. Development of downstream products from bio-technologically processed edible bird nest produced new value-added, innovative invention products from the traditional raw edible swiftlet nests. Therefore, the commercialisation part and new market development will be a priority areas in the future work.

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