

## COMPLETION REPORT

### **A study on the Strawberry-based Product, Packaging and Storage Technologies in Japan Food Industries**

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Strawberry or scientifically known as *Fragaria x ananassa* Duch belongs to the Rosaceae family are non-climate crops that can be planted in subtropical, temperate and tropical regions. The strawberries are rich in anthocyanin and vitamin C, high in moisture content, an acidic pH (ranging from 3.39 to 3.8 upon ripening) and taste sweet. The variety cultivated depends on the region of planting as the effects of temperature, photoperiod and humidity are the main requirements for strawberry growth. Japan is among the top producers of strawberries with noticeable quality. Malaysia plants strawberries in the highland regions but only for local consumption. Malaysian strawberries planted in the Cameron Highlands region are mostly done by small-scale farmers and often face post-harvest losses due to the highly perishable nature of strawberries and lack of information on available processing technologies. Several factors contributed to strawberry fruits losses and deterioration including the effect of improper handling, storage condition and spoilage/pathogenic bacteria attack. Drying and pasteurisation processes are the most common practices done in strawberry processing due to the effectiveness of the treatments in extending their shelf-life. Thus, the intended study was done to compare the cultivation and post-harvest practice of strawberries between selected farms in Malaysia (Cameron Highlands) and Japan (Nagano and Hokkaido Prefectures). Nagano is located about 200 km from Tokyo, Japan has a dry climate with low annual precipitation rates. Hokkaido Island is located in the north of Japan having extreme weather during the winter which popular with winter variety strawberries. Strawberries in Malaysia planted in Cameron Highlands which also known as Hill Station as it is located 1,500 meters above sea level on Titiwangsa Range. A case study approach was used in this study through questionnaires and informal interviews to obtain the required information on demographics, cultivation practices and technology used by farmers of the selected farms. Based on the obtained information, selected farms in Nagano Prefecture and Hokkaido Prefecture were cultivating strawberries in greenhouses with elevated bed system and irrigation techniques, whereas the farms from Cameron Highlands cultivated strawberries by planting in an open area covered with rain shelters. The strawberries farmers in Hokkaido Prefecture will not planting strawberries during winter except for the big farms that will produce strawberries around the year using modern technologies. The strawberries in all the selected farms in Japan mainly used a manual grading process during the strawberry picking process. Processing of strawberries into other products often done on a small-scale by the farmers and sold directly at the farm and distribute to other local sellers and supermarkets which portray “from farm to fork” practice. Strawberries processed into products such as jam, drinks and ingredients in bakery goods labelled as premium in Japan which often sold in a specialty shop. Manufacturing of strawberry-based products made in Malaysia took HALAL certification as the main quality assurance standards in food processing whereas, Japan manufacturing follows the Good Agricultural Practice (GAP). The market value of strawberries from Nagano and Hokkaido was also higher compared to Cameron Highlands, despite the minimal differences in farm infrastructures.

イチゴ（学名：Fragaria x ananassa, オランダイチゴ属 Rosaceae の栽培品種群）は四季成り性の作物で熱帯，亜熱帯，温帯地域で栽培可能である（日本では，一季成り性品種も多い）。イチゴはアントシアニンとビタミン C が豊富で水分が高く，成熟時の pH は 3.39 から 3.8 で酸性であり甘い味がする。世界各地域で栽培される品種は，温度，湿度，日長などの栽培環境の影響を受けてそれぞれ異なる。日本は高品質イチゴの生産で有名である。マレーシア国内でも標高の高い地域でイチゴが栽培されているが，その消費は栽培地域に限定されている。マレーシアのイチゴ栽培地域はキャメロン（Cameron）高原地域であり，大部分は小規模農家による生産である。イチゴは本来日持ち性が悪くまた収穫後の処理技術が不十分なため，キャメロン高地で生産するイチゴは収穫後のロスが大きい。イチゴの品質劣化とロスの要因として，収穫後のハンドリングが適切でないこと，保管条件が不適切であること，腐敗菌による影響などがあげられる。イチゴの日持ち期間を長くするために乾燥（ドライフルーツ）や殺菌などが行われている。

上記の問題の解決を目指して，マレーシアのキャメロン高地と日本の長野県および北海道のイチゴ農家における栽培や収穫後処理に関する比較研究を実施した。マレーシアでは Titiwangsa 山脈の標高 1500m 付近の Hill Station と呼ばれるキャメロン高地でイチゴが栽培されている。それぞれの地域で選択した農家に対して，アンケートや直接インタビューの手法で就業人員や栽培方法収穫後技術について調査した。

調査結果によれば，長野県や北海道ではイチゴはハウス内で高設水耕栽培（常設した温度制御する温室内で腰の位置の高さに培養液栽培槽を設けた設備）をする例が多く，一方，キャメロン高地では露地栽培で上部に雨除けの被覆をした栽培が多かった。北海道では，一般農家は冬は雪のためにイチゴの栽培出荷はしていないが，大規模な生産者は最新の植物工場により通年の栽培出荷を行っている。調査した日本のすべての農家は人手によるイチゴの選択収穫（イチゴ果実の成熟状態を人間が判断し収穫適期の果実のみを収穫する）を行っている。イチゴの加工販売（生食用ではない販売）は小さな農家でも行っている例が多く，地域の販売業者やスーパーマーケットに製品を直接出荷している。これは，“農場から食卓へ”の実践例である。日本では，イチゴのジャムや飲料，ケーキなどへの加工品は高級品として専門店でも多く販売されている。マレーシアのイチゴ加工品は，食品には不可欠な品質保証基準であるハラール（HALAL）認証を取得している。一方で日本では農業生産工程管理（Good Agricultural Practice, GAP）に則り生産されている。調査した範囲で，日本とマレーシアのイチゴ農家の農場規模（栽培面積）はそれほど大きな差異がないにもかかわらず，長野県および北海道から生産されるイチゴの市場価値（価格）はキャメロン高地から生産されるイチゴよりも高かった。

Publication of the Results of Research Project:

Verbal Presentation (Date, Venue, Name of Conference, Title of Presentation, Presenter, etc.)

**1<sup>st</sup> Paper**

Date : 21- 22 August 2019

Venue : Kuala Lumpur

Name of Conference : Global Halal Sphere Conference (GloHas 2019)

Title of Presentation : A Review : Nutrition Quality And Processing of Malaysia Strawberry.

Author : Rosnah Shamsudin

Presenter : Rosnah Shamsudin

**2<sup>nd</sup> Paper**

Date : 11 – 13 August 2020

Venue : Kuala Lumpur

Name of Conference : International Conference on Agricultural and Food Engineering (CAFEi2020)

Title of Presentation : From farm to fork: cultivation, postharvest and processing of strawberry in Japan.

Author : Rosnah Shamsudin

Presenter : Rosnah Shamsudin

Thesis (Name of Journal and its Date, Title and Author of Thesis, etc.)

**1<sup>st</sup> Paper**

Name of Journal & Date : Food Research. 2020

Title : A review: nutrition quality and processing of Malaysia strawberries

Author of Journal : Rosnah Shamsudin

**2<sup>nd</sup> Paper**

Name of Journal & Date : International Journal of Academic Research in Business and Social Sciences. 2020

Title : A Comparison of Strawberry Cultivation: Case Study of Selected Farms in Malaysia and Japan

Author of Journal : Rosnah Shamsudin

**3<sup>rd</sup> Paper**

Name of Journal & Date : Agricultural Economics. 2020 (on-going submission)

Title : Strawberry processing in selected Malaysia and Japan's manufacturer: A case study approach

Author of Journal : Rosnah Shamsudin

**4<sup>th</sup> paper**

Article published in local Newspaper

Name of Newspaper & Date: Utusan Malaysia, 29 September 2019

Title : Strawberi Hibrid Jepun berbuah sepanjang tahun (The Japanese strawberries hybrid are available all year round)

Author of Article: Rosnah Shamsudin

(Copy of the Journal as attached)

Book (Publisher and Date of the Book, Title and Author of the Book, etc.)

**Malay version :**

Publisher and Date of the Book : UPM Press. 2020 (Still under review and evaluation; target publish Sept 2020)

Title : *Travelog Strawberi di Bumi Sakura* (Strawberry Travelogue in the land of Sakura).

Author of the Book : Rosnah Shamsudin, Shuso Kawamura and Eriko Yasunaga

**Japanese version :**

After this book is published in the Malay language, it will be translated and published in the Japanese language.

Target publish on December 2020

Author of the Book : Rosnah Shamsudin, Shuso Kawamura and Eriko Yasunaga