

THE TUDAN'S ORGANIC MULBERRY TEA: AN INDIGENOUS COMMUNITY TEA PRODUCT MADE UNDERUTILIZED PART OF MULBERRY PLANT

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ABSTRACT

Kampung Tudan is located at the rural area and protected under buffer zone of Crocker Range Biosphere Reserve Area by UNESCO, where human and society live in harmony. Mulberry plantations have been introduced as an alternative economic activity to enhance their livelihood. Tudan's Organic Mulberry Tea was made locally in Kampung Tudan, is an innovative product made up from the mulberry leaves into tea product. Fresh leaves from mulberry plant was harvested, dried using community solar powered dryer for the production of the tea and the formulation is under Trade Secret by the Centre for Research and innovation which belongs to Universiti Malaysia Sabah. A few series of laboratory test have been conducted on Tudan's Organic Mulberry Tea such as physicochemical analysis and consumer sensory evaluation. Results shows that, mulberry tea powder considerable high in protein with stable shelf life. There were about 100 panels majority from student has been evaluated Tudan's Organic Mulberry Tea based on four sensory test which are aroma, color, taste, mouthfeel and their overall acceptance. Overall acceptance scores for Tudan's Organic Mulberry Tea is more than 30%. The newly developed tea product, has been undertaken by Kampung Tudan villager's cooperative, Koperasi Kampung Tudan Berhad and has commercialized in the market since January 2017. The product is priced at RM 19.90 per box and has generated more than RM 95, 081 revenues since January 2017.

Keywords: high protein; innovative product; Koperasi Kampung Tudan Berhad; stable shelf life; Tudan's Organic Mulberry Leaves Tea

1.0 INTRODUCTION

Kampung Tudan is located at the buffer zone and remote area of Crocker Range Biosphere Reserve area (CRBR) acknowledged by the UNESCO. Thus, restricting the villagers from performing any industrial activities other than plantation. Tudan villagers have lived long below the hardcore poverty line earning average RM 400 monthly which was substantially less than what was being spent (Fiffy *et al.*, 2017). Cash income was primarily derived from the sale of vegetables crops, sale of livestock such as domesticated pigs and forest-based products.

The mulberry trees have been planted in Kg. Tudan, Tuaran, Sabah which is located at western slopes of the Crocker Range in northern section of the Crocker Range Park. It

was about 27 km east of Kota Kinabalu and under Tuaran District. Approximate elevation is 1,130 m asl and surrounded by sloping land. There were 315 persons with total number 42 households in Kg. Tudan. Since olden days, the local community has been applied traditional Swidden farming practice to plant rice and vegetables as their source of livelihoods. However, the sloping land surface at Kg. Tudan limited their agricultural activities. The innovation here is to make use of the insignificant leaves from mulberry plant into a commercialise product with market value to improve the livelihood of geographically challenged community in Kampong Tudan. Tudan's Organic Mulberry Tea was made locally in Kampung Tudan, is an innovative product made up from the mulberry leaves into tea product.

This project was led by Universiti Malaysia Sabah with aim to make use of the insignificant leaves from Mulberry Plant into commercial able products with premium market value, to generate sustainable income through mulberry products via an established social enterprise, to improve the livelihoods of economically and geographically challenged community in Kampung Tudan and to transform traditional farmers into agro-entrepreneur. A few series of laboratory test have been conducted on Tudan's Organic Mulberry Tea such as physicochemical analysis and consumer sensory evaluation.

2.0 LITERATURE REVIEW

Mulberry leaves are broadly perennial and broadleaf woody plant and widely grown in a Mediterranean climate. Mulberry has abundant ecotypes during long term of natural selections. Most of the species are originated and cultivated in China. This plant can grow to 10 m height, flowering season from April to May and fruits ripening from July to September. Delicious mulberry fruit has 2-3 cm long, with approximate weight 5-6 g and in black purple colour. Fruits fall from the trees when they fully ripen. Fruits of black mulberry have aromatic, laxative and anti-pyretic actions.

The mulberry leaf was claimed to have complete nutritional composition. Many researchers have proven the mulberry leaf contained approximately 22% - 25% of crude protein in dry mulberry leaf. 1 mu of mulberry leaf is equal to 110 kg protein of 200 kg of soy bean. The nutritional value of mulberry leaf contained about 80% - 100% more than grass and 40% - 50% more than leguminous pasture. 100 g dried weight of mulberry leaf contain about 6% of crude fats, 3101 mg Potassium and 2699 mg of Calcium. The leaf also claimed to be high in vitamins such as flavanoid, flavanoid-glycoside, steroids, volatile components, and microelements which are useful for improving disease resistance.

Being an excellent source of nutrients and physicochemicals, mulberry has been established as functional food (Srivastava *et al.* 2006). The leaves are highly palatable (Srivastava *et al.* 2006) and play a pivotal role in the sericulture industry because they serve as the sole food of silkworm (*Bombyx mori*) (Sanchez, 2000). The leaves are also cultivated for dairy animal feed due to the positive effect on milk production (Gupta *et al.* 2005). Herbal tea made from mulberry leaves are consumed as a healthy beverage among Asian countries (Chen *et al.* 2016). In the folk remedies, various parts of mulberry tree, including root bark, leaves and fruits, have been traditionally used for the treatment of fever, cough, hyperlipidaemia, hypertension and hyperglycaemia (Chen *et al.* 2016). Mulberry leaves-derived products in the form of powders, extracts and capsules are now commercially available as functional foods and dietary supplements for controlling body weight and blood glucose.

Tudan's Organic Mulberry Tea is natural herb tea drink and made up from 100% of mulberry leaves with no addition of food preservatives or food coloring. Corresponding with the organic drinks qualification, the plantation of mulberry trees also fulfilled the requirement with zero usage of pesticides and chemical fertilizer. According to Euromonitor, consumer demand for tea will continue to grow over the forecast period, as health-consciousness is driving consumers to drink more tea as it contains less caffeine than coffee. Tea is expected to grow at a CAGR of 2% at constant 2016 prices over the forecast period. Off-trade sales of tea grow by 4% in current terms in 2016 to reach RM 261 million, while off-trade volume sales grow by 1% to reach 6.166 tonnes (Euromonitor, 2017).

Tea is the extract of leaves, leaf nodes and internodes of plant which is brewed as extract in hot water rather than being eaten in leaves form. Tea also containing an aromatic liquid product when the leaves brewed in hot boiling water (Xiao *et al.*, 2006). Consumption of tea was popular among Chinese people and continuously well-known around the world. It was believed that regularly consuming tea contribute to the daily dietary requirement of some of the important minerals (Powell *et al.*, 1998) which are attributes to richness in important substances having cool, a little bitter flavor, antioxidant properties and health benefits (Dimitrios, 2006). The chemical components in tea include alkaloids (theobromine, caffeine, theophylline), polyphenols (catechins, flavonoids), amino acids, polysaccharides, volatile acids, vitamins, lipids as well as inorganic elements (Monobe *et al.*, 2008; Wei *et al.*, 2010; Xiong *et al.*, 2012). According to many researchers, consuming tea in form of powders, soft extracts and strong infusions (Gardner *et al.*, 2006) will gain these health benefits because tea has substances that can act as antitumor (Dimitrios, 2006), anti-carcinogenic (Katiyar & Mukhtar, 1996) and anti-arteriosclerotic agents (Mukhtar *et al.*, 1994).

However, chemical composition of tea varies and depending on climatic conditions, horticultural practices, soil quality, growth altitude, plucking season, sorting, grading, processing, extraction, storage and drying (Pelillo *et al.*, 2002 and Le Gall *et al.*, 2004) that may affect the taste, flavor and health benefits of a specific type of tea (Hara *et al.*, 1995) due to direct association between tea quality and the content of tea amino acids, caffeine and polyphenols in tea leaf (Cheng, 1983 and Khalid *et al.*, 2011).

3.0 METHODOLOGY

3.1 Sample Collection and Preparation

Fresh mulberry leaves were harvested by hand plucked and rinse under running tap water. The leaves then dried utilizing green energy via community solar powered dryer (Morus Dryer) and grinded using blender to get small size particles of leaves powder. Blended mulberry leaves then packed into 1gram empty nylon pyramid tea sachets with attractive decorated tag. This product contains uses all-natural ingredients and it is sugar free with no added preservatives.



Figure 1: Process flow of Tudan's Organic Mulberry Leaves Tea production

Morus Dryer works based on harnessing the heat from bulbs. In the event of rainy season or no-sun weather, the design is made to accept electricity that is stored in the battery. The Morus dryer also can be scaled up and scaled down efficiently to meet the requirement of users. The dryer has capacity of drying 8 kg of leaves per month with low current capacity taking up only 6A per hour. Besides, the dryer is convenient to be used and maintained as the only maintenance needed is the bulbs.

Since this dryer is powered by solar power, it has significantly benefited the community as well as the environment. With this green energy compared to the electrical energy, it will save the cost of tea production and reducing carbon dioxide released into air by 750 kg per year. The lifespan of the dryer is expected to be 3 years with replacement of woods. Due to high demand of capacity, the community intends to upscale the number of Morus dryer into industrial scale capacity which has just been granted under MOSTI Technology Fund in the late 2017.

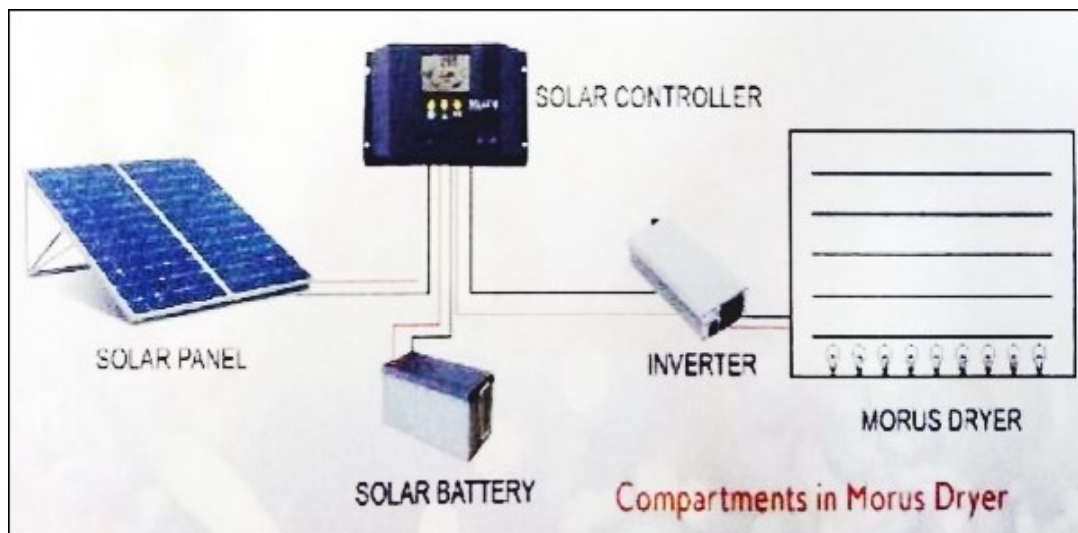


Figure 2: Compartments in Community solar powered dryer (Morus Dryer)

3.2 Physicochemical analysis and Consumer Sensory Evaluation

100 gram of dried mulberry leaves sample then sent into private laboratory for their physicochemical analysis. The analysis including moisture content in tea samples, crude protein, percentage of fat contents, crude fiber contents and ash contents. The result took about one month and their nutritional values then tabulated in tables and approved for Tudan's Organic Mulberry Leaves Tea certified box labelling. Sensory evaluation of tea samples was conducted to evaluate the quality rating of tea for color, taste, aroma, mouthfeel and overall acceptability. 1g of tea sample were infused with 250 ml freshly boiled water for ten minutes and then the liquid was poured into 250ml tea tasting porcelain bowl for quality assessment. There were about 100 panel of non-trained judges (tea lover) was employed for sensory evaluation of tea samples. Before start of the evaluation a training session of 15 minutes was conducted with the panelists. Afterwards, one sample at a time was offered to each member.

The sensory testing was made in the panel room with controlled temperature and relative humidity. The panel room was completely free of food/chemical odors, unnecessary sound and mixing of daylight. Judges were provided with prescribed questionnaire to record their sensory observations. A 7-point hedonic face scale (Beinner, 2010) was used which contained extremes that indicated "very much disliked" (1) to "liked very much" (7) is more suitable for untrained panels.

4.0 FINDINGS

4.1 Physicochemical analysis of Tudan's Organic Mulberry Leaves Tea

Data regarding physicochemical analysis of commercial tea samples was tabulated in Table 1. Result shown Tudan's Organic Mulberry Leaves Tea was high in crude protein content (19.9 g /100 g of dried mulberry leaves). Tudan's Organic Mulberry Leaves Tea can be claimed has good protein source of plants and also 0% of fats. The moisture analysis shown Tudan's Organic Mulberry Leaves Tea has stable shelf life and expected can be properly stored in dry places for about 1 year.


Another important factor is use of packaging material to maintain a constant moisture level during storage of commercial tea samples, so moisture content in commercial tea is an essential parameter of quality. (Yao *et al.*, 2006) also observed 70% of commercial tea samples having moisture content of 6.6% or less and 30% sample containing more moisture percentage up to 8% which can have negative effect on shelf life of the product, so for the better quality of the product moisture percentage should be controlled between 2.5-6.5%.

The low fiber content in tea samples may be attributed to younger tea leaves. High fiber content in tea samples may be due to use of impurities like stems during processing. In addition to this, crushing tearing and blending process also destroy the leaf structure that might have effect on fiber content. The higher ash content in tea might be due to less moisture content in tea. Previous researchers also indicated positive relationship between ash content and keeping quality of tea and proposed that ash content should be controlled less than 5.54% in order to maintain quality of tea during storage (Ismail *et. al.*, 2000 and Rehman *et. al.*, 2002).

Table 1: Physicochemical analysis Tudan's Organic Mulberry Leaves Tea sample

ANALYSIS RESULTS				
(As per sample)				
No.	Test Parameters	Result	Units	Method Reference
1.	CRUDE FAT	ND (< 0.1)	g/100g	IN-HOUSE METHOD QWI-OF/17-10 BASED ON METHOD OF ANALYSIS FOR
2.	CRUDE FIBER	0.7	g/100g	IN-HOUSE METHOD QWI-OF/17-9 BASED ON PEARSON'S (1991) PAGE 2
3.	PROTEIN / CRUDE PROTEIN	19.9	g/100g	QWI-OF/17-6 BASED ON METHOD OF ANALYSIS FOR NUTRITION LABELING (1993)
4.	ASH	10.7	g/100g	QWI-OF/17-2 BASED ON METHOD OF ANALYSIS FOR LABELING (1993) CHAP. 10
5.	AVAILABLE CARBOHYDRATE (DERIVED FROM ASH, MOIST, PROT, FAT & DF)	19.9	g/100g	QWI-OF/17-37 BASED ON METHOD OF ANALYSIS FOR NUTRITIONAL LABELING AND MALAYSIAN FOOD ACT 1983
6.	MOISTURE	8.5	g/100g	QWI-OF/17-38 MOISTURE ANALYZER

(ND - Not Detected)


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4.2 Consumer sensory evaluation of Tudan's Organic Mulberry Leaves Tea

Figure 3 shows the sensory evaluation results for Tudan's Organic Mulberry Leaves Tea based on their colour, mouthfeel, aroma and taste. Highest mean score for evaluated aspect is color of Tudan's Organic Mulberry Leaves Tea with mean score about 5.98, followed by its mouthfeel (mean score = 5.96), aroma (mean score = 5.85) and taste (mean score = 5.78). Overall acceptance for Tudan's Organic Mulberry Leaves Tea is in between mean score 5.78 to 5.98 indicated majority of panels slightly like Tudan's Organic Mulberry Leaves Tea. Tudan's Organic Mulberry Leaves Tea has mild greenish color might be depending on oxidation and fermentation process during tea processing. The amino acids in tea also having significant role in color production which may be oxidized by catechins resulting in tea liquor color (Ying *et al.*, 2005; Thippeswamy *et al.*, 2006). In addition, other tea components such as thearubigins and theaflavins are also affecting the sensory characteristics of the tea especially brightness of tea color (Owuor & Obanda, 2001). Tudan's Organic Mulberry Leaves Tea was expected contained almost 0% of caffeine content. According to (Owuor & Obanda, 2001), the better flavor score in commercial tea containing more amounts of caffeine and thearubigins. At the same time, the quality of tea is strongly associated with the amount of caffeine content for the formation of flavoured during infusion process (Smith *et al.*, 1993). The amounts of other components such as thearubigins, theaflavins, amino acids, and catechins also have a significant contribution in the sensory characteristics of tea (Kato *et al.*, 2008).

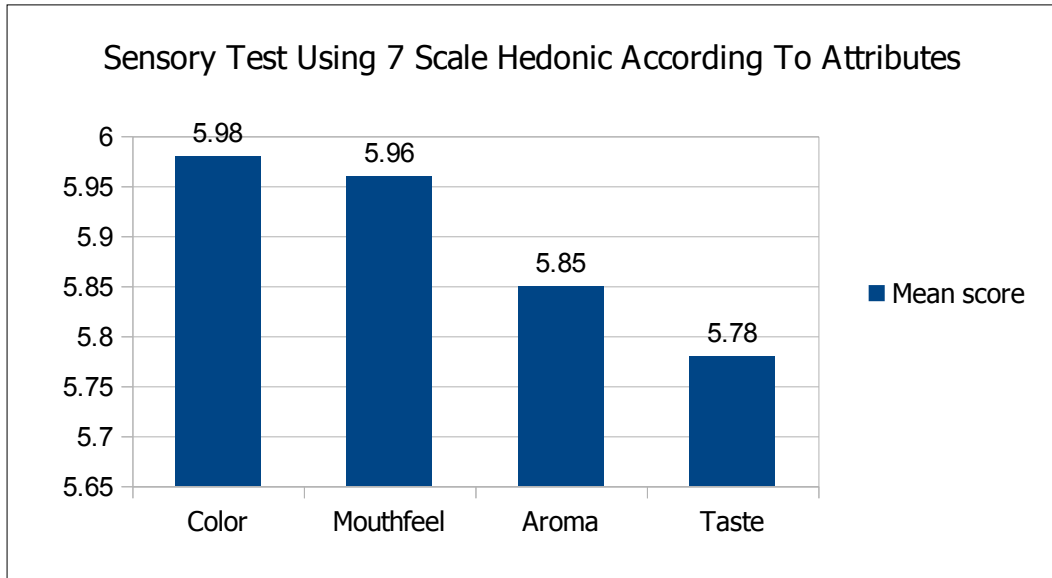


Figure 3: Consumer sensory evaluation of Tudan’s Organic Mulberry Leaves Tea using 7 points hedonic scale according to attributes.

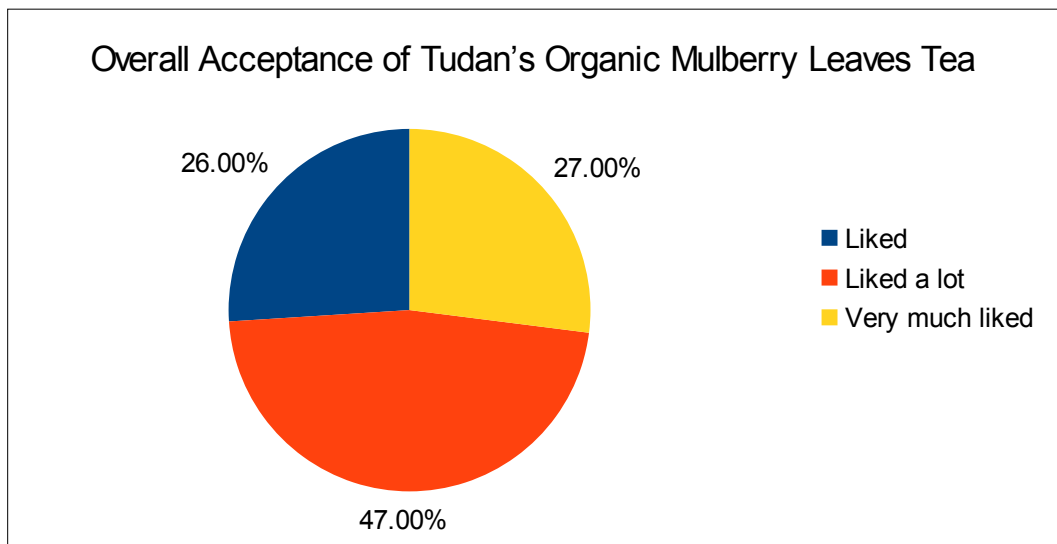


Figure 4: Chart pie of overall acceptance of Tudan’s Organic Mulberry Leaves Tea by employed panel.

According to pie chart in Figure 4, 100% of employed panels are tea lover and they liked Tudan's Organic Mulberry Tea Leaves. Tea lovers among the employed panels are identified based on tea consumption rate for every panel that was ranged from everyday up to once per week. There were about 47% of panels evaluated Tudan's Organic Mulberry Leaves Tea as liked a lot meanwhile only 26% of panels evaluated as liked only. Thus, all of panels are satisfied with the overall aspect such as color, mouthfeel, taste and aroma of Tudan;s Organic Mulberry Leaves Tea. In addition, color, taste, flavor and mouthfeel factor, panels consumary behavior also affecting the results of overall acceptance of Tudan’s Organic Mulberry Leaves Tea in term of ages and gender which is affecting their degree of tea consumption (Savita *et. al.*, 2010).

5.0 CONCLUSION

Consumer studies has shown that Tudan's Organic Mulberry Leaves Tea are well accepted and has high market potential with 85% of consumers would buy the product. The newly developed tea products, has been undertaken by Kampung Tudan villager's cooperative, *Koperasi Tudan Berhad* (registered under *Suruhanjaya Koperasi Malaysia*) and has commercialized in the market since January 2017. The product is priced at RM 19.90 per box and has generated more than RM 95, 081 revenues since January 2017. The tea product line has now expanded to Ready to Drink (RTD) market locally, chilled mulberry drink has been introduced to local market (*tamu*) and offer for cash on delivery order within Kota Kinabalu City since September 2017. 2

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