Asia Pacific Journal of Advanced Business and Social Studies
ISBN (eBook): 978 0 9943656 7 5 | ISSN : 2205-6033
Year: 2016 , Volume: 2, Issue: 2

STUDY ON THE NUTRITIONAL VALUES AND CUSTOMER ACCEPTANCE OF *Lansium domesticum* &*Nephelium lappaceum* NEWLY FERMENTED NATURAL FRUIT VINEGARS IN MALAYSIA

Seri Intan Mokhtar[a], Faznira Zakaria[b], Mohammad Amizi A[c],
Siow Woon Soon[d], Nurshahida. A.S[e], Zul Ariff Abdul Latiff[f]
[abcdef]University Malaysia Kelantan, Jeli Campus, Kelantan, Malaysia
Corresponding email: intan@umk.edu.my

Abstract

Every fruit season, the orchard farmers are facing fruit overloading which leads towards fruit dumping. *Nephelium lappaceum* (local name: Rambutan) and *Lansium domesticum* (local name: Dokong) vinegars were produced by natural microbial fermentation to overcome the dumping problem. The vinegars nutritional values and customer acceptance studies were conducted to compare against commercially available vinegars in Malaysia. Rambutan and Dokong vinegars nutritional value were shown to contain the same carbohydrate, protein and fat value with the apple cider vinegar and Attap seed (nipa) vinegars. Both vinegars contained two times higher Potassium, four times lower Sodium and eight times higher calcium compared to Apple Cider Vinegar. The survey method by using the structured questionnaire was used as a tool for collecting data and information. A total of 177 respondents by using stratified random sampling filled up the questionnaire in selected location in Kuala Lumpur and Kelantan to obtain the result on acceptance of this natural fruit vinegar product. The result indicated most of the customers preferred the vinegar from fruit compared to Attap seed (nipa) vinegar and artificial vinegar. In addition, Halal and the nutrition value of the product are of concerned to the consumers.

Keywords: Nutritional value, Customer acceptance, Dokong, Rambutan, vinegar

1. Introduction

Since centuries, vinegar has been part of the human diet as a condiment and food preservative, as well as the basis for simple remedies for people and animals. Usually vinegar is made from several sugary and starchy materials such as fruits, malt, sugar cane juice etc. by alcoholic and subsequent acetic fermentation (Tan, 2005). FAO/WHO defines vinegar as any liquid, fit for human consumption which is produced exclusively from suitable products containing starch and/or sugars by the process of double fermentation, first alcoholic fermentation and then a certification. The residual ethanol content must be less than 0.5% in wine vinegar and less than 1% in other vinegars (FAO, 2000). According to Malaysian Food Regulation 1985, vinegar shall be a liquid product prepared from the alcoholic fermentation and subsequent acetous fermentation of any suitable food. Vinegar shall contain not less than 4% w/v of acetic acid and shall not contain any mineral acid. Vinegar may contain permitted preservative, caramel as a colouring substance and spices as permitted flavouring substance.

However, the production of natural vinegar is unfavourable among the manufacturers in Malaysia. Many of the producers refuse to produce natural vinegar due to several reasons such as the availability of the substrates and long fermentation time (6-8 weeks). Moreover, the price of synthetic vinegar is still much lower than natural vinegar in local market. Natural vinegar

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production has only been practised as a cottage industry in many states in Malaysia using various types of agro-based products and by-products as substrates such as coconut sap, nipah sap and matured fruit juice. There was no standard practice being followed by the local farmers and entrepreneurs thus, have resulted in interference of contaminants, non-hygienic processes, and un-standardized percentage of acetic acid and nutrition information in the marketed vinegar (Othaman et al., 2014).

Market for vinegar is wide spread. Traditionally, it acts as a preservative or condiment of food, vinegar also has been used for antiseptic and act as medicine for aches and gastric problems (Ali & Herani, 2013). Domestic use is limited, but it is used in large quantities in restaurants, clubs and canteens and by the caterers. There are some established brands in the market like Chings, Weikfield and others. There are many food products utilizing vinegar as ingredients indirectly such as ketchup, sauce, mayonnaise making the demands of vinegar increased steadily (Tan, 2005). The trend in consuming natural vinegar in Malaysia is on the increase now, but mostly on imported vinegars such as apple cider, date and pomegranate vinegars. However, except for nipa and coconut vinegars, the tropical fruit vinegar in Malaysia has not been commercialized (Karim et al., 2011). The customer's preference of vinegars in Malaysia is also under studied.

Therefore, the objective of this study is to make comparison of proximate values, mineral elements and heavy metals of locally made fruits vinegar from Rambutan and Dokong with apple cider vinegar and nipah vinegar (Mas et al., 2014). Forecast accounts were determined for both local fruits vinegars in requirement for economic feasibility of the Rambutan and Dokong vinegars in order to attract investment. Moreover, customer's preferences, knowledge and acceptance towards Rambutan and Dokong natural vinegars were surveyed to support data on current trend in vinegar consumption in Malaysia.

2. Materials and method

Sample of vinegars for analysis

Fruits juice extracts of Rambutan and Dokong were fermented for 42 days to produce vinegars. Apple cider and Nipa vinegars were purchased from a supermarket in Kelantan. About 100 ml samples were taken from each fruits vinegars for the proximate analysis.

2.2 Proximate analysis

2.2.1 Moisture content

Thermal drying method was used in the determination of moisture content of the samples. 10 ml of dried sample was weighed in triplicate and placed in crucibles. The crucibles were washed, dried, weighed and being filled with sample and then placed in an oven for drying at 105°C for 3 hr, allowed to cool in a desiccator and then reweighed. The percentage moisture content was calculated by the following formula:

$$\% \text{ moisture} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,
W_1 = *Weight of sample before drying*
W_2 = *Weight of sample after drying*

2.2.2 Total solid contents

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Total solids were estimated by deducting percentage of moisture from hundred.

2.2.3 Crude fat

Extraction of the fat was carried out by Soxtec System. Aluminum cups were heated at 103 °C for 30 minutes and were dried in desiccator for 20 min, weighed and recorded. Samples were prepared by soaking a filter paper in 1 ml of the vinegar and were dried in oven at 103° C for 2 minutes. The samples were weighted in the thimbles and recorded. A layer of de-fatted cotton was placed on the top of the sample and was inserted into the extraction unit.

Each of the aluminum cups was filled with 80 ml petroleum ether and was inserted into the extraction unit with the cup holder and left to run for about 20 min. After the extraction process, the cups were removed, heated at 103 °C for 30 min in a drying oven and dried in desiccators for 20 min. All cups weights were recorded. Crude fat was determined by the following formula:

$$\% \text{ Crude Fat} = \frac{W3-W2}{W1} \times 100$$

Where,
W1 = weight of sample
W2 = Weight of empty Aluminum cup
W3 = Weight Aluminum cup + fat residue

2.2.4 Crude protein

For digestion process, 10 ml of distilled water, 12 ml of concentrated sulphuric acid, two pieces of Kjeldahl tablets and one gram of samples were inserted into a digestion tube. All digestion tubes were placed in an insert rack of the control unit and were heated at 400 °C for 1 hr. The samples were left to cool for at least 30 min in a fume hood.

For distillation process, the receiver solution was prepared by dissolving 4 g Boric acid in 100 ml distilled water to make 4% Boric acid. 1 ml Bromocresol green and 0.7 ml methyl red were added and stirred on a stirring hotplate with medium temperature to dissolve completely. 30 ml from the solution was pipetted into each receiver flask to starts the analysis until the receiver solution in the conical flask turned from red to green colour. The flask was removed and titrated against 0.1N Hydrochloric acid (HCl) for determination of Kjeldahl nitrogen, which in turn gave the protein content. The nitrogen percentage was calculated by the following formula:

$$N\% = \frac{(\text{ml of sample} - \text{ml of blank}) \times \text{normality of HCl} \times 14.007 \times 100}{\text{Weight of sample (mg)}}$$

Thus, protein content will be estimated by conversion of nitrogen percentage to protein (James, 1995).

Protein % = N% x Conversion factor (6.25)
Where conversion factor = 100/N (N% in fruit products)

2.3 Determination of minerals and heavy metals

2.3.1 Preparation of samples

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20ml of samples was placed in a 100 ml volumetric flask, 10 ml of HCl was added and the volume was marked up with distilled water and was filtered to remove solid particles. The standards for minerals and heavy metals were prepared containing the same acid and lanthanum concentration as samples. Dilutions for samples were necessary for elements present in high concentration. Lanthanum was used when detecting Potassium, Sodium, Magnesium and Calcium elements. Then, the standard at different concentration was run following with the samples using Atomic Absorption Spectroscopy (AAS).

2.4 Determination of forecast account

2.4.1 Determination of profit and loss statement

- Profit is determined by the money from sales, cost of stock and all the expenses.
- Sales= commissions paid / discounts given + cost of goods + gross profit
- Gross profit = variable + fixed expenses + net profit.
- Sales, gross profit and net profit are the income earned by the business.
- Cost of goods, commissions/discounts, variable and fixed expenses are business expenses.

2.4.2 Determination of NPV, IRR and ROI

- NPV= The present value of an investment's future net cash flows - the initial investment
- IRR = The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments.
- Benefit/Cost ratio = Net present value / investment value
- ROI = Benefit – Cost/Cost

2.5 Customer preferences towards fruit vinegars in Malaysia

Survey was conducted to obtain the necessary data using questionnaires which were distributed to a sample size at two states, one in East Coast of Malaysia (Kelantan) and another one in The West Coast of Malaysia (Kuala Lumpur)by using the stratified randomized sampling to identify the difference perception and acceptance level towards the tropical natural fruit vinegars. A Total of 177 respondents answered the questionnaires of which 69 respondents from Kuala Lumpur and 108 respondents from Kelantan.

3. Results and Discussion

The proximate analysis data in local fruits vinegar and commercialized vinegar used for present investigation are presented in Table 1.The analytical data reveals showed that all of the values are $p < 0.05$ significantly different except for protein value ($p > 0.05$). Apple cider vinegar and nipa vinegar have the highest moisture value which is 98.49% and 96.17%, respectively, while the local fruits vinegar moisture value range between 81.47% – 92.49 %. For total solid content, Rambutan vinegars showed the highest value which is 18.53% and apple cider vinegar was the lowest, 1.51%. Total solids are measure of the amount of material dissolved in water. This material can include carbonate, bicarbonate, chloride, sulphate, phosphate, nitrate, calcium, magnesium, sodium, organic ions and other ions (American Public Health Association, 1998).However, ash, carbohydrate and fiber content cannot be determined due to low residue content. Protein content were in the same range between all of vinegars where rambutan vinegar

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has the highest, 0.27% while apple cider vinegar has the lowest protein content which is 0.13%. Fat content was found highest in Dokong vinegar which is 0.59% and the lowest was found in rambutan and nipa vinegar which is 0.07%. The differences of pH value between local fruits vinegars with the apple cider vinegar were not obvious which local fruits vinegar range from 3.48 to 3.88 while apple cider is 3.10 and nipa vinegar is 2.86. The highest amount of total soluble solid (TSS) was found in Rambutan vinegar, 16.41 °Brix and the lowest in apple cider vinegar, 3.60 °Brix. Generally, higher TSS indicates more sugar in the pulp where the level of sugar in pulp shows the level of ripening of the fruits (Haque et al., 2009). Basically, 1 °Brix is equal to 1% of sugar content (USDA, 2011). For titratable acidity rambutan vinegar has the highest, 7.45% while apple cider and nipa vinegar ranges from 6.34% to 6.40%.

Table 1. Proximate Analysis of Fruit's Vinegars

	Rambutan Vinegar	Dokong Vinegar,	Apple Cider Vinegar	Nipa Vinegar
Moisture (%)	81.47 ± 3.13^{a}	92.59 ± 1.15^{b}	98.49 ± 0.15^{c}	96.17 ± 0.09 ^{bc}
Total solid content (%)	18.53 ± 3.13^{c}	7.41 ± 1.15^{b}	1.51± 0.15^{a}	3.83 ± 0.09 ^{ab}
Ash (%)	0.00	0.00	0.00	0.00
Protein (%)	0.27 ± 0.09^{a}	0.18 ± 0.04^{a}	0.13 ± 0.05^{a}	0.25 ± 0.17^{a}
Fat (%)	0.07 ±0.02^{a}	0.59 ± 0.15^{b}	0.08 ± 0.02^{a}	0.07 ± 0.02^{a}
Carbohydrate (%)	0.00	0.00	0.00	0.00
Fiber (%)	0.00	0.00	0.00	0.00
Energy (%)	0.07 ± 0.02^{a*}	0.59 ± 0.15^{b*}	0.08 ± 0.02 ^{a*}	0.07 ± 0.02^{a*}
pH	3.48 ± 0.09^{c}	3.88 ± 0.06^{d}	3.10 ± 0.00^{b}	2.86 ± 0.01^{a}
Total Soluble Solid (°Brix)	16.41 ±0.66^{d}	6.06 ± 0.52^{b}	3.60 ± 0.00^{a}	6.80 ± 0.00^{b}
Titratable Acidity (%)	7.45 ± 0.51^{b}	3.56 ± 0.79^{a}	6.34 ± 0.35^{b}	6.40 ± 0.06^{b}

Values are expressed as mean ± SD of triplicates measurements superscripts with different letters are significantly different at $p < 0.05$ within the same row
* Energy is obtained from Fat (%)

The analytical data in Table 2 shown that that the mineral content in the local fruit vinegars was significantly different ($p < 0.05$). Potassium level was significantly higher in local fruit vinegars compare to apple cider vinegar and nipa vinegar where the highest was in dokong vinegar which is 387.67 mg/kg. Sodium was significantly lowest in nipah vinegar which is 61.79 mg/kg while highest in apple cider vinegar at482.37 mg/kg. Calcium was found to be lowest in commercialized vinegar whereby value is not detected in nipa vinegar and only 4.93 mg/kg in apple cider vinegar compared to rambutan vinegar at 39.15 mg/kg and Dokong at 15.25 ± 1.51.Nipa vinegar has significantly lowest amount of magnesium at 21.25 mg/kg. Rambutan vinegar has highest amunt of Magnesium at 59.28 mg/kg. Results showed that the tropical fruits vinegar contained a moderate amount of manganese where rambutan vinegar has the highest at 2.06 mg/ kg and the lowest amount found in nipah vinegar at 0.02 mg/kg. The highest amount of zinc was found 21.11 mg/kg in apple cider vinegar and lowest level found in Nipa vinegar at 0.36 mg/kg.

Table 2. Mineral elements of Fruits' Vinegars

Minerals (mg/kg)	Rambutan Vinegar	Dokong Vinegar,	Apple Cider Vinegar	Nipa Vinegar

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Potassium, K	250.23 ± 28.56^{b}	387.67 ± 97.61^{c}	133.30 ± 18.53^{ab}	101.15 ± 8.96^{a}
Sodium, Na	112.33 ± 28.54^{b}	97.47 ± 13.43^{ab}	482.37 ± 3.31^{c}	61.79 ± 1.67^{a}
Calcium, Ca	39.15 ± 2.43^{d}	15.25 ± 1.51^{c}	4.93 ± 0.08^{b}	ND^{a}
Magnesium, Mg	59.28 ± 11.61^{b}	44.97 ± 18.81^{b}	39.11 ± 0.10^{ab}	21.25 ± 0.63^{a}
Manganese, Mn	2.06 ± 0.21^{d}	0.89 ± 0.03^{c}	0.55 ± 0.07^{c}	0.02 ± 0.00^{a}
Zinc, Zn	0.86 ± 0.05^{c}	0.56 ± 0.03^{b}	21.11 ± 0.05^{d}	0.36 ± 0.03^{a}
Iron, Fe	2.12 ± 1.14^{a}	0.93 ± 0.08^{a}	3.88 ± 0.10^{b}	1.53 ± 0.08^{a}

Values are expressed as mean ± SD of triplicates measurements superscripts with different letters are significantly different at $p < 0.05$ within the same row
* ND = Not Detected

From the study, trace heavy metals for lead was not detected in the entire sample except for nipa vinegar, at 0.16 ppm. Cadmium and chromium were also not detected in the entire sample. It is showed that the values for copper and nickel are significantly different ($p< 0.05$).The highest amount of copper was in rambutan vinegar, 0.87ppm while the lowest in nipa vinegar at 0.02 ppm. For Nickel, apple cider vinegar was the highest, 6.62 ppm and the lowest was found in dokong vinegar, 0.15 ppm. The acceptable range of Nickel in daily intake is 3-7mg/day (Ismail et al.,2011).The higher levels of heavy metal contamination found in some fruit and vegetables could be closely related to the pollutants in irrigation water, farm soil, and pesticides or alternatively could be due to pollution from traffic on the highways (Othman & Mbogo, 2009).

Table 3. Heavy Metals in Fruits' Vinegars

Heavy metals (ppm)	Rambutan Vinegar	Dokong Vinegar,	Apple Cider Vinegar	Nipa Vinegar
Lead, Pb	ND^{a}	ND^{a}	ND^{a}	0.16 ± 0.04^{b}
Cadmium, Cd	ND	ND	ND	ND
Chromium, Cr	ND	ND	ND	ND
Copper, Cu	0.87 ± 0.06^{b}	0.14 ± 0.04^{a}	0.20 ± 0.11^{a}	0.02 ± 0.01^{a}
Nickel, Ni	0.20 ± 0.07^{a}	0.15 ± 0.08^{a}	6.62 ± 1.68^{b}	5.06 ± 1.13^{b}

Values are expressed as mean ± SD of triplicates measurements superscripts with different letters are significantly different at $p < 0.05$ within the same row
* ND = Not Detected

A profit and loss statement shows planned and actual profit for the business. Based on Table 4, it is showed that rambutan and dokong vinegar is a profitable product. This is shown by the gross profit and profit/loss after taxation of both vinegars already gained profit in year 1. Gross profit for rambutan vinegar in year 1 is RM 38, 803 and by the year 5, it is increased to RM 56, 812 by assuming sales and purchases prices are up 10% every year. However, the gross profit for dokong vinegar is lower compare to rambutan vinegar yet still profitable which is RM 12, 677 in year 1 and increased to RM 18, 560 in year 5. This occurred due to low percentage of acetic acid in pure dokong vinegar, thus required only small dilution compared to rambutan vinegar. For the balance sheet, for rambutan vinegarnet asset and shareholder net worth for year 1 is balanced which is RM 16, 949while for dokong vinegar is RM 11, 823.

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Table 4. Profitability Statements of local Fruits' Vinegars

	Rambutan Vinegar		Dokong Vinegar,	
	Year 1	Year 5	Year 1	Year 5
Starting Capital	RM 10,000	-	RM 10,000	-
Cost of sales	RM 99,437	RM 145,585	RM33,979	RM49,749
Sales of vinegar	RM 138, 240	RM 202,397	RM46,656	RM68,309
Gross profit	RM 38, 803	RM 56, 812	RM 12, 677	RM 18, 560
Profit/loss after taxation	RM 6,949	RM 10, 478	RM 1,823	RM 2,972
Net asset	RM 16, 949	RM 53, 148	RM 11, 823	RM 21, 851
Shareholder net worth	RM 16, 949	RM 53, 148	RM 11, 823	RM 21, 851

The net present value (NPV) is the present value of an investment's future net cash flows minus the initial investment. If positive, the investment should be made unless an even better investment exists, otherwise it should not. In this study, the NPV is positive gained in year 2 which is RM 6,912.00 for rambutan vinegarwhile dokong vinegar is in year 4 at RM 2,251.64. The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments. In the context of savings and loans, the IRR is also called the effective interest rate. For the IRR of rambutan, vinegar is 30% where the present value in year 2 is RM 11,495.10 while for dokong vinegar is 10% in year 5 where the present value is RM 11,537.41. Benefit or cost ratio is the ratio of the net present values of measurable benefits to costs where value above 1 simply means the investment is beneficial. This showed that rambutan and dokong vinegars are beneficial investment where rambutan vinegar cost ratio is 3.771 while dokong is 1.440. Payback period in capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment. Payback period for RM10,000 initial investment for rambutan vinegar is in year 2 which is RM 11,495.10 while for dokong vinegar is in year 5 which is RM 11,851. The actual cost of projects may deviate on change of any of the assumptions.

Table 5. Forecast Key Indicators

	Rambutan Vinegar	Dokong Vinegar,
NPV	Year 2 = RM 6,912.00	Year 4 = RM 2,251.64
IRR	Year 2 = RM 11,495.10 (30%)	Year 5 = RM 11,537.41 (10%)
Benefit/Cost ratio	3.771	1.440
Payback period	Year 2 = RM 11,495.10	Year 5 = RM 11,851

Table 6 showed that there were 69 respondents from Kuala Lumpur (KL) and 108 respondents from Kelantan. Compared with the aged, most of the respondents are within the age group of 25-34yr (41.2%) following by the age group of 18-24yr (35.0%), 35-44 yr (11.9%), 45-54yr (7.9%) and 55yr and above (4.0%). While for gender, there were 47.5% and 52.5% of Male and Female respondents respectively. Around 46.9% of respondents are married, 52.5% single and 0.6% from respondents are windowed. As for the Educational levels, most of the respondents are at

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university level (58.8%) and Secondary school level (19.8%) following by Certificate (12.4%), Others education level (7.3%), Primary school (1.1%) and not attend to formal school (0.6%). Among all the respondents, there are 83.1% Malay, 14.1% Chinese, 1.1% of Indian and 1.7% people from other races. For religion, there are 83.6% of Muslims, 9.6% of Buddhist, 4.5% of Christians, 1.1% of Hindus and people from others religion are 1.1%. Moreover, people who are working in public sector are 41.8%, Students or Unemployed are 23.2%, private sector 14.1%, other options 11.3%, self-employed 6.2%, Housewife and Retired people from the total respondents are both 1.7% respectively. Furthermore, Income of respondents is mostly at the level of less than RM2000 (55.4%), follow by category of RM2001-RM4000 (31.6%), RM4001-RM6000 (11.3%) and RM6001 and above (1.7%).

Table 6 Respondents Demographic Characteristic

VARIABLE		Frequency	Percent
Region	Kelantan	108	61.00
	Kuala Lumpur	69	39.00
Age	18-24 years	62	35.0
	25-34 years	73	41.2
	35-44 years	21	11.9
	45-54 years	14	7.9
	55 and above	7	4.0
Gender			
		84	47.5
	Female	93	52.5
Marital Status			
	Married	83	46.9
	Single	93	52.5
	Window	1	0.6
Education Level			
	No Formal Schooling	1	0.6
	Primary School	2	1.1
	Secondary	35	19.8
	Certificate	22	12.4
	University	104	58.8
	Others	13	7.3
Race			
	Malay	147	83.1
	Chinese	25	14.1
	Indian	2	1.1
	Others	3	1.7
Religion			
	Muslims	148	83.6
	Christians	8	4.5
	Hindu	2	1.1

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	Buddhist	17	9.6
	Others	2	1.1
Occupation			
	Private Sector	25	14.1
	Public Sector	74	41.8
	Self-employed	11	6.2
	Housewife	3	1.7
	Unemployed	41	23.2
	Retired	3	1.7
	Others	20	11.3
Current Income			
	Less than RM2000	98	55.4
	RM2001-RM4000	56	31.6
	RM4001-RM6000	20	11.3
	RM6001 and above	3	1.7

To determine the consumers' perception, general information and knowledge about vinegar have been collected in this study. Table 7 presents the respondents' awareness towards vinegar product. There are 39.55% of respondents are from Kelantan and 29.38% of Kuala Lumpur people responded that they like vinegar in general. Meanwhile, 21.47% are from Kelantan and 9.60% of from Kuala Lumpur people dislike vinegar product in general. This result shows respondents from the two regions are consumers for vinegar, especially respondents in Kelantan.

Among people who responded that they like vinegar product, 16.36% of respondents from Kelantan and 8.20% of respondents from Kuala Lumpur preferred Artificial Vinegar. Meanwhile, 37.70% of that respondent from Kelantan and 33.61% of respondents from Kuala Lumpur preferred Natural Vinegar. This show Natural Vinegar is more preferred by the consumers in both regions compared to artificial vinegar. Furthermore, for people who preferred Natural vinegar, 33.61% of respondents from both regions tend to take natural fruits vinegar compared to Nipa vinegar (20.49% Kelantan; 6.56% Kuala Lumpur). Most of the respondents from both region (33.15% Kelantan and 22.95% Kuala Lumpur) consume vinegar several times a week. In addition, 30.33 % of respondent from Kelantan acknowledge the benefits of vinegar compared the Kuala Lumpur (28.69%).

Table 7: The Comparison response of customers' preferences and Knowledge towards vinegar products

Statement	Kelantan n (%)	Kuala Lumpur n (%)
Like or Dislike Vinegar		
Like	70 (39.55)	52 (29.38)
Dislike	38 (21.47)	17 (9.60)
If 'Like', what kind of vinegar is used		
Artificial Vinegar	20 (16.39)	10 (8.20)
Natural Vinegar	46 (37.70)	41 (33.61)
Both Artificial and Natural	4 (3.28)	1 (0.82)
If natural vinegar, what type of natural vinegar		
Fruits	41 (33.61)	41 (33.61)

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Nipa	25 (20.49)	8 (6.56)
Both fruits and nipa	4 (3.28)	3 (2.46)
How often respondents consume Vinegar products		
Everyday	8 (6.56)	6 (4.92)
Once a week	14 (11.48)	9 (7.38)
Several times a week	38 (31.15)	28 (22.95)
Others	10 (8.20)	9 (7.38)
Do you know the benefits of Vinegar product?		
Yes	37 (30.33)	35 (28.69)
No	33 (27.05)	17 (13.93)

As shown in Table 8, those who like vinegar are significantly influenced by gender (0.05), marital status (0.02), race (0.016), religion (0.011) and occupation (0.023). On the other hand, type of vinegar preferred by the respondent is influenced by the marital status (0.05) and occupation (0.024) only. Moreover, occupation of the respondent significantly determines the choice of type of natural vinegar purchased so as the Frequency for usage of the vinegar. From the finding, we can conclude that preference on like of vinegar is depending on gender, marital status, race and religion. Type of vinegar is depending on marital status and occupation. The type of natural vinegar preferred and frequency of used is depending on occupation of the respondents. The reason could be that occupation of the respondent influence the knowledge in usage of the vinegar. It seems that occupations of respondent are playing important factors in determining the customer preferences on vinegars.

Table 8Pearson Chi-Square Coefficient (n=177) (knowledge about vinegar)

Factors	**Like vinegar**	**Type of Vinegar**	**Type of Natural Vinegar**	**Frequency for usage of Vinegar**
Gender	**Significant (0.050)**	In significant	In significant	In significant
Marital status	**Significant (0.021)**	**Significant (0.050)**	In significant	In significant
Race	**Significant (0.016)**	In significant	In significant	In significant
Religion	**Significant (0.011)**	In significant	In significant	In significant
Occupation	**Significant (0.023)**	**Significant (0.024)**	**Significant (0.027)**	**Significant (0.049)**

*Correlations are significant at 0.05 levels (two-tailed).

Conclusions

From the results, local fruit vinegars from Rambutan and Dokong have a significant amount of good sources of nutrition based on their excellence nutritional profiles and quality attributes. Both products could be a beneficial investment based on the forecast accounts. Overall, results of respondents from Kelantan and Kuala Lumpur both have high percentage on acceptance for

Asia Pacific Journal of Advanced Business and Social Studies
ISBN (eBook): 978 0 9943656 7 5 | ISSN : 2205-6033
Year: 2016 , Volume: 2, Issue: 2

Natural Fruit Vinegar products. Marital status and occupation are playing important factors in determining the customer preferences on vinegars. This could be an indication to show that market potential for tropical natural product is positive in Malaysia especially on demographic factors on marital and occupation status. To pursue this vinegar industry, priority needs to be given on marital status and occupation towards the natural fruit vinegar.

Acknowledgement

This part of research work was supported by the Grant R/SGPG/Tropical Fruit Vinegar/Dr Seri Intan sponsored by GERIC, Universiti Malaysia Kelantan.

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