

## The application of *tahawwul* (transformation) process for determination of vinegar status in the Malaysia market

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### Abstract

*Tahawwul* is a changing process of a form to another form thus could affect the status of a particular *ḥukm* especially in vinegar products. Vinegar which produced before the *tahawwul ṣaḥīḥ* can be considered as low-quality vinegar and is classified as *fasīd* vinegar (*ḥarām*) due to the presences of alcohol which is prohibited in Islam. Therefore, in this study, twenty-five different types of vinegar in Malaysian market were tested using Gas Chromatography attached with Flame Ionization Detector (HS-GC-FID) with Head Space Analyzer (HS-10) and Gas Chromatography (GC) with time of flight mass spectrometry (TOF-MS) to find out the contents of alcohol and acetic acids present in the said vinegar products. The results showed that majority of the sample were ḥalāl. However, there were two types of vinegar that were not considered ḥalāl because these products did not go through a complete process of (*tahawwul ṣaḥīḥ*).

## 1. Introduction

Islam had stated that every food that consumed by Muslim must be *ḥalālan tayyiban*. There are vast aspects when it comes to ḥalāl in contrast to ḥarām which are little and very limited (Al-Ghazālī, 2006). Although the ḥalāl things are more extensive than of ḥarām, there are other aspects that are still unclear of its ḥalāl status; such as vinegar that contains alcohol. The presence of alcohol in food or beverages is a much-debated issue among consumers; due to the trace of alcohol in the food or beverages that are very much associated to the ḥalāl status (Riaz, 1997). Alcohol is a chemical compound that could cause intoxication when consumed over the allowed limit. It is categorized as ḥarām (forbidden) in the Islamic teachings regardless of the size of the intakes (Najiha and Wan Nadiyah, 2014). Alcohol had existed for a very long time in food and beverages (Deedat, 1991) especially the ones that are produced through the fermentation process. However, in sharia law, there is a purification process of something that is ḥarām to become ḥalāl and it is called as *tahawwul*. *Tahawwul* can

be asserted as a phase or transfer, which is the change of a *ḥukm* to another *ḥukm* with the clear reason (Al-Tahānawī, 1996) in other words *tahawwul* could mean a change of a form to another which may bring effect on the status of a particular *ḥukm* (Wizāraṭ al-Awqāf Wa Shuūn al-Islāmiyyah al-Kuwait, 1983). *Tahawwul* also means a change of substance to something else (Amsīwīt, 2016) which includes the physical exchange and its nature (Al-Zuḥaylī, 1985) such as the change of unclean (*najs*) being clean, such as the transformation of blood into milk or the transformation of *khamr* into vinegar. Naturally, every product that is produced through the fermentation process would consist of alcohol either in a big or small percentage. This is because the alcohol or specifically ethanol will form through the fermentation of fruits, cereals and starch with the aid of yeast (Zohri and Etnan, 2000).

Alcohol can be produced through the fermentation process either naturally or industrially. Through the fermentation process, there are several products that can be produced namely juice, *nabidh*, *khamr* and vinegar.

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Every product that is produced through the process of fermentation, will also have different *hukm* namely *halāl*, *harām* and *shubhah*. The difference in the *hukm* happened because of the presence of alcohol in the products produced, besides the fermentation period in the manufacturing stage of a product such as vinegar. This can also determine the legal status and *hukm* of the vinegar product. The fermentation period determines the variety of vinegar produced, but generally, the vinegar produced through the traditional process takes a much longer time than the fermentation period in producing the modern-day *nabidh*, *khamr* and vinegar (Ghanem, 2014), some of which are produced through natural processes requires a longer fermentation period; between five and six weeks (Hailu et al., 2012) while the other types of vinegar require a longer period of fermentation that could go up to 40 days to 3 months depending on the type of vinegar and its source. This might also take a longer period and could reach up to a year. Vinegar produced through the traditional process is said to be of superior quality as compared to the vinegar produced through the modern process. This is because the traditionally processed vinegar will undergo the converting process from substances that contains sugar and requires a much longer period of time. The slow conversion process from natural ingredients will produce a higher quality of vinegar. The vinegar processed in this way is usually more flavorful and tastes better than the fast produced vinegar (Orey, 2009).

However, as the demand for high-grade vinegar products grows, some manufacturers have marketed their vinegar products even though they have not yet reached the mature fermentation or *tahawwul saḥīḥ* process. *Tahawwul* is the purification method which turns something that is originally *tāhir* (clean) to become *najs* (unclean) and to *tāhir* (clean) again as in the making of vinegar (Wizāraṭ al-Awqāf Wa Shuūn al-Islāmiyyah al-Kuwait, 1983). The vinegar that is produced before the *tahawwul saḥīḥ* are mainly considered as a low-quality vinegar. Apart from that, the alcohol content that is still in the process of turning into vinegar is diminutive, resulting in a high alcohol content that could implicate to the *harām* status of the vinegar. The vinegar that is produced through a *tahawwul saḥīḥ* will not only be a high-quality vinegar but it is also guaranteed to be *halālan tayyiban* and free from alcohol.

Therefore, this study is aimed to identify the *halāl* status of vinegar in the Malaysian market by using the concept of *tahawwul* or transformation as an alternate determination of the *halāl* status of vinegar. This is by looking at the alcohol content and acetic acid that exists in the final product of the vinegar using a scientific approach. It is common to know that vinegar is produced

through a double fermentation process involving *takhammur* or the conversion of carbohydrates or sugars to alcohol and *takhallul* or the alcohol conversion into acetic acid (Jamaludin et al., 2017). Therefore, by studying the final product of vinegar found in the Malaysian market, it is possible to identify whether the vinegar products are *halāl* or *harām* or whether the vinegar is considered *shubhah*.

## 2. Materials and methods

### 2.1 Materials

A total of twenty-five kinds of vinegar were acquired from different places in the Malaysian market. All of the samples are as stated in Table 1.

Standard acetic acid at 1, 10, 30, 50 and 70 ppm was used to produce a calibration curve in order to determine the acetic acid concentration in commercial vinegar.

### 2.2 Sample preparation

A total of 4 mL of vinegar sample was transferred in a glass vial and 25 ppm of IPA was added as an internal standard for ethanol content analysis. Then, 250 µL samples were mixed with 1 mL of 2500 ppm acetonitrile as an internal standard to make the Internal Standard concentration become 50 ppm. Then the mixture is added with distilled water to reach 50 mL in the volumetric flask. Before the samples are ready to be injected, the mixture was shaken for about 10 s to homogenize the mixture. After that, 500 µL of 5000 ppm sample was transferred into a vial and the sample was then injected into the GC-TOF/MS automatically by using the auto sampler sample injection. The steps were then repeated up to three times to ensure the results are fixed and consistent.

### 2.3 Analysis of ethanol content

An analysis of the ethanol content in every sample of vinegar out using gas chromatography (Shimadzu GC 2014) attached with the Flame Ionization Detector (HS-GC-FID) with Head Space Analyzer (HS-10). The analysis was performed in duplicate. The percentage of ethanol content was obtained from the chromatogram produced. A Headspace Sampler (HS-10) Gas chromatograph coupled with flame ionization detector (GC FID-2014) Shimadzu Corporation Japan was employed in this study.

### 2.4 Analysis of acetic acid content

The acetic acid content was performed using the Gas Chromatography (GC) with Time of Flight Mass Spectrometry (TOF-MS) (Leco, St. Joseph, MI, USA). In this study, GC-TOF/MS was performed using an Agilent

Table 1. List of 25 vinegar samples tested in the study

Sample ID	Names and types of vinegar	Categories of vinegar	Original country	Status Logo
V1	Palm Vinegar (Cuka Nipah)	Traditional/ Natural	Malaysia	Non-Halal Logo
V2	Pak Man Warisan Tradisi Palm Vinegar (Cuka Nipah)	Traditional/ Natural	Malaysia	Non-Halal Logo
V3	Ikhwan Synthetic (Artificial Vinegar)	Industry	Malaysia	Non-Halal Logo
V4	Tamin Synthetic (Artificial Vinegar)	Industry	Malaysia	Halal Logo
V5	Khall Sakanjabeen Botanical drinks (Formula Vinegar)	Industry	Malaysia	Halal Logo
V6	Narcissus (Rice Vinegar)	Industry	China	Non-Halal Logo
V7	Wan Ja Shan (Rice Vinegar)	Industry	Taiwan	Non-Halal Logo
V8	Mizkan Sushi Vinegar (Rice Vinegar)	Industry	Japan	Non Halal Logo
V9	Heinz All (Natural Distilled White Vinegar)	Industry	Pittsburgh- Pennsylvania (United States)	Non-Halal Logo
V10	Tiparos (Distilled White Vinegar)	Industry	Thailand	Halal Logo
V11	Bragg Organic Raw-Unfiltered (Apple Cider Vinegar)	Industry	United States	Non-Halal Logo
V12	SandW Premium (Apple Cider Vinegar)	Industry	United States	Non-Halal Logo
V13	Sahara (Apple Vinegar)	Industry	Malaysia	Non-Halal Logo
V14	Halawatussunnah Organic (Apple Cider Vinegar)	Industry	Turkey	Halal Logo
V15	Narcissus (Black Vinegar Yongghun Laogu)	Industry	China	Non-Halal Logo
V16	Cheong Chan (Black Vinegar)	Industry	Malaysia	Halal Logo
V17	Radix (Date Vinegar)	Industry	Malaysia	Non-Halal Logo
V18	Fars (Date Vinegar with honey)	Industry	Malaysia	Halal Logo
V19	Fars (Fig Vinegar)	Industry	Middle East Product (Imported and Packed By Malaysia Manufacture)	Halal Logo
V20	Al-Fasal (Pomegranate Vinegar)	Industry	Middle East Product (Imported and Packed By Malaysia Manufacture)	Halal Logo
V21	Tesco (Malt Vinegar)	Industry	United Kingdom	Non-Halal Logo
V22	Alce Nero Organic (Balsamic Vinegar of Modena)	Industry	Italy	Halal Logo
V23	Vinigen (Rose Vinegar)	Industry	Taiwan	Non-Halal Logo
V24	Petitzel Fruity Small Indulgency (Fruit Vinegar for Drink)	Industry	Taiwan	Non-Halal Logo
V25	Vinigen (Pineapple Vinegar)	Industry	Taiwan	Non-Halal Logo

time-of-flight mass spectrometer (Leco Software). Each sample (1  $\mu$ L) was injected into an Agilent 7890 Gas Chromatography system equipped to a Pegasus Time of Flight (tof)-Mass Spectrometer detector (Leco, St. Joseph, MI, USA). Compounds were separated on an Rtx-5MS capillary column (30 m x 0.25 mm; film thickness, 0.25  $\mu$ m). Helium carrier gas was used at a constant flow rate of 1.2 mL/min. The temperature program for metabolome analysis started with a 70°C for 1 min and followed by temperature ramping of 5°C/min to a final temperature of 100°C in split mode, which was maintained for 1 min. The acquisition rate was set to 30 spectra per second with the mass range of 20-1000 m/z. MS Pegasus-IV system (LECO, St. Joseph, USA) equipment with a liquid nitrogen quad-jet modulator and

CTC CombiPal Autosampler (CTC Analytics, Carrboro, NC, USA) was used in this study. The analysis was carried out in triplicate.

### 2.5 Analysis of pH content

The pH of all vinegar samples was measured using pH meter (Fisher Science) was used to measure the pH of the vinegar samples. pH meter was calibrated prior used by using different buffer at pH 4.01, pH 7.01 and pH 10.01 to check the accuracy of the instrument. Then, the pH electrode was placed into the 10 mL vinegar sample in a beaker at room temperature (25°C) and the reading was recorded. All the result was recorded in triplicate and the average value was determined.

### 3. Results and discussion

Vinegar is one of the oldest traditional foods produced through the fermentation process. Generally, Muslim consumers believe that all vinegar is categorized as *halāl* product, and it is classified as one of the favourite food of the Prophet Muhammad (P.B.U.H). However, the status *hukm* of vinegar is still uncertain since the presence of alcohol and concentration of an acetic acid reflect the halalness of a product. Vinegar is an acidic liquid, a fermentation product that contains acetic acid and alcohol as well as trace elements and flavoring. It was produced by the fermentation process either slowly or rapidly and the content depends on the substrate and the original ingredients used. Vinegar produced through the fermentation of ethanol and alcohol using bacteria to break down the ethanol into byproducts including acetic acid. Since the presence of alcohol and concentration of an acetic acid reflect the halalness of a product, therefore, ascertainment of alcohol and acetic acid content is necessary.

#### 3.1 Islamic approach to *Halāl* vinegar

In general, Islam recognizes vinegar as a *halāl* food and commonly used as an *idām* (condiment) that is ideal for health and digestion (al-Subkī, 1984), it is also considered as a *sunnah* food that is favored by the Prophet Muhammad (P.B.U.H). However, Prophet Muhammad (P.B.U.H) did not particularly mention the method of making it, the source used in the manufacturing process, the storage method, the preparation method and the required fermentation time until it becomes vinegar. In the absence of clear guidance from the Prophet, there are traders who sell their products even though the vinegar are still in the *takhammur* state: which is the state where sugar changes into alcohol. The state of *takhammur* in the manufacturing of vinegar begins after the maximum period in the manufacture of *nabidh*.

*Nabidh* is a type of beverage produced from the fruit juice (Ibn Manzūr, 1997). It is also made from the soaking of dates, raisins, honey, wheat, cereals and so on (Ibn Mūsā, 2003; Ibn Abī Hātim, 2006). A *halāl nabidh* is called *nabidh ghair muskir* in contrast to the *harām nabidh*; where it is called *nabidh muskir* or also known as *khamr* and it can be intoxicating (Al-'Ainī, 2001; Al-Nawawī, 2008). *Nabidh ghair muskir* or *halāl nabidh* is made from the extraction or soaking of dates, raisins in the period of permissible fermentation, while *nabidh muskir* or *harām nabidh* is produced during the fermentation period which exceeds the allowed period by sharia. The production of *nabidh* requires fermentation periods to allow the sugar content contained in the raw materials to be soluble and mixed with water. The

duration of its fermentation provider can be divided into two parts, the minimum and maximum duration.

The minimum required time for *nabidh* fermentation is not more than 12 hours, which is between 8-12 hours only. There are some hadiths that explain that the Prophet Muhammad (P.B.U.H) drink *nabidh* at midnight when he prepared it at night and when the *nabidh* is prepared during the daytime, the Prophet Muhammad will drink it at night. The hadiths are as follows:

'A'isha reported: We prepared *nabidh* for Allah's Messenger in a water skin, the upper part of which was tied and it (the water skin) had a hole (in its lower part). We prepared the *nabidh* in the morning and he drank it in the evening and we prepared the *nabidh* in the night, and he would drink it in the morning. (Saḥīḥ Muslim, Book 23, Hadith no.4977).

The maximum period allowed in the extraction/consumption of *nabidh* is three and a half days as stated in the following hadith.

Based on these hadiths, the minimum level of alcohol can be produced before reaching the level on which is considered to be *khamr* is between 8 and 12 hours, while the period that exceeds that period is at the evening of the third day or in other words, 72 hours is considered the maximum permissible time to drink *nabidh*, at that time *nabidh* can be used as long as it tastes sweet, unchanged and not bubbling or boiling (Al-Nawawī, 1996), but after the third day the Prophet did not drink it because it was feared that it contained high alcohol and could be harmful to health. In this case, the process of formulation of *khamr* has begun and can be categorized as the *takhammur* process, at this stage the product produced will be *khamr* and if the product is used at this time, it is considered *harām*. This is because it is still in the second process of fermentation or in other words it is entering the state of *khamr*.

However, the state of *takhammur* in vinegar preparation takes a longer process than the fermentation process to produce *nabidh* and the state of *takhallul* in vinegar preparation is longer than fermentation process to produce *khamr* that can last for months and even a year (Budak et al., 2014). Therefore, there is a mistake in determining the end of this *takhammur* process. The *takhammur* process will end when it enters the *takhallul* level which is the change of alcohol to acetic acid (vinegar). but the main thing to observe is that in this *takhallul* process, there is also a change that leads to *shubhah*, if the *takhallul* process is still early due to the conversion of alcohol to acetic acid that has not changed as a whole, the perfect *takhallul* process occurs when the whole alcohol content has turned into acetic acid. To find

out the exchange, the *tahawwul* method is needed to ensure that any change is applicable to the product and its law.

### 3.2 Science approach to test the Halalness of vinegar

In the science perspective, vinegar ( $\text{CH}_3\text{COOH}$ ) is a chain that has a hydroxyl group (-OH) bonded to a carbon atom where the carbon atom is also bound to hydrogen atoms and or to other carbon atoms. Vinegar is a chemical liquid that has a very close relationship with alcohol (R-OH), because it is produced by ethanol oxidation process ( $\text{CH}_3\text{CH}_2\text{OH}$ ) by vinegar bacteria or also called acetic acid bacteria (AAB) of the genus *Acetobacter* that added to an alcoholic liquid such as wine, apples and beers, ( $\text{C}_2\text{H}_5\text{OH}$ ) into acetic acid (Bhat *et al.*, 2014). Physical and chemical properties of vinegar are almost identical to alcohol, in the form of non-colored liquids, with a very strong and sharp smell, volatile and easily inhaled and have a sour taste with pH or acid content between 2.40 - 3.40 while cider vinegar is 3.10 (USFDA / CFSAN, 2007).

Acetic acid, Ethanoic acid or acid vinegar is a chemical compound of organic acids known as sour flavor in food. Vinegar has a  $\text{C}_2\text{H}_4\text{O}_2$  empirical formula. This formula is often written in the form of  $\text{CH}_3\text{-COOH}$ ,  $\text{CH}_3\text{COOH}$  or  $\text{CH}_3\text{CO}_2\text{H}$ . Pure acetic acid (called glacial acetic acid) is colorless, hygroscopic liquid, and has a frozen point of  $16.7^\circ\text{C}$ . Acetic acid is one of the carboxylic acids (R-COOH), an organic compound containing a carboxyl group (COOH), in which the hydroxyl group (-OH) is directly affixed to the carbonyl group (C = O). Vinegar is the simplest acid after formic acid (HCOOH) followed by Propionic acid  $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$  which exists as a liquid at room temperature (Myers, 2007).

In general, vinegar can be formed, and modified in various ways, it is produced naturally and manmade from natural ingredients such as apples, bananas, rice and dates or from wine and apple cider (De Rovira, 2008) it can be understood as a product produced from cider, but specifically the vinegar cannot be formed directly from the cider, in other words, it is impossible to change directly into vinegar. Sugar compounds must first change into alcohol, through the fermentation process and then the alcohol will turn into acetic acid (Chen *et al.*, 2016). With this statement, it is also understandable that the vinegar produced from rum, wine, whiskey or other alcoholic beverages require only one level: the changing stage from alcohol to acetic acid. Therefore, vinegar produced from alcoholic beverages can be produced directly from this fluid (Patel and Pandya, 2015). But alterations of alcoholic beverages such as wine and whiskey are valid through the chemical process

in which ethyl alcohol turns into acetic acid. The changing process also involves bacteria known as *Acetobacter* (a.k.a. the vinegar bacteria) into acetic acid ( $\text{CH}_3\text{CO}_2\text{H}$ ) through oxidation (Tan, 2005).

In Islam, a product can be categorized as *halal* if the product is originated from *halal* ingredients, manufactured according to the *halal* standards towards and at the end of the manufacturing process; a *halal* product. Therefore, even vinegar can be produced from wine, but the *halal* status is still uncertain. Although each vinegar product contains more than 90 different compounds such as hydrocarbons, carbonyls, esters, tartaric acid, citric acid, lactic, malic and other organic acids, there are two components that are the main focus of this study, namely alcohol and acetic acid. A product is not called vinegar unless the product had undergone the process of fermentation of the alcohol. Other than that, the vinegar should also contain acetic acid as the main component giving the sour taste in vinegar, but the acidity of a vinegar product must meet the standards prescribed by the law of nutrition especially the Malaysian food laws.

Analytical content of the acetic acid and alcohol are obtained by using High-Throughput Gas Chromatography with Time-of-Flight Mass Spectrometer Pegasus Time of Flight (tof) detector (Leco, St. Joseph, MI, USA) and Headspace Sampler (HS-10) chromatograph gas coupled with flame ionization detector (GC FID-2014) Shimadzu Corporation of Japan had found that acetic acid and ethanol content in vinegar products are different according to the product category and type of vinegar produced as portray in Figure 1 and Table 2.

### 3.3 Analysis of acetic acid content

In general, vinegar is a product that contains acetic acids, the contents of acetic acid vinegar is different according to the type and source of its preparation. Acetic acid is a major component of vinegar products, and it is a major component of vinegar that can give a sour taste to the product. Malaysia Food Regulations 1985 prescribes the contents of acetic acid in vinegar to contain no less than 4% volume for each weight of acetic acid (Malaysia Food regulation, 1985). This provision is also a resolution prescribed by the United States Food and Drug Administration (FDA). The higher the percentage of acetic acid found in the vinegar then it will affect the level of reduction in the percentage of alcohol content in vinegar. From the results obtained, most vinegar contained less than 4% of acetic acid. The highest is Fars Date Vinegar with honey with 0.032% then SandW Premium Apple Cider Vinegar with 0.029%, followed by Alce Nero Organic Balsamic

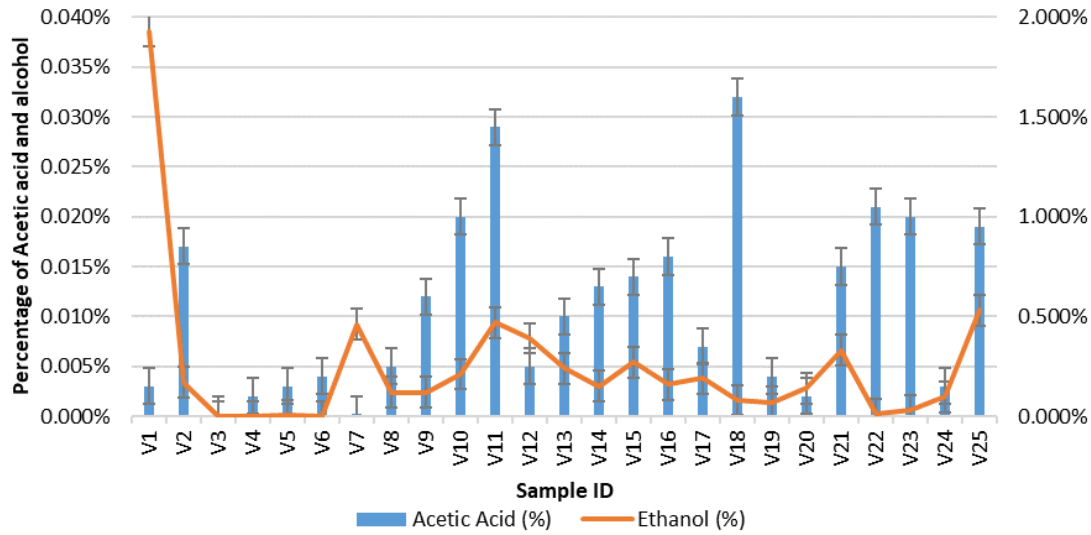


Figure 1. The percentage of alcohol and acetic acid in vinegar

Table 2. 25 Types of vinegar and content of alcohol and acetic acid (%)

No.	Sample ID	Amount of Alcohol (%)	Amount of Acetic acid (%)	pH value
1	V1	1.93%	0.00%	2.91±0.02
2	V2	0.17%	0.02%	2.83±0.01
3	V3	Not Detected	0.00%	2.41±0.01
4	V4	Not Detected	0.00%	2.59±0.01
5	V5	0.01%	0.00%	2.86±0.01
6	V6	Not Detected	0.00%	2.85±0.01
7	V7	0.46%	0.00%	3.06±0.01
8	V8	0.12%	0.01%	2.75±0.01
9	V9	0.12%	0.01%	2.77±0.02
10	V10	0.21%	0.02%	2.62±0.01
11	V11	0.39%	0.01%	3.11±0.01
12	V12	0.47%	0.03%	1.82±0.01
13	V13	0.24%	0.01%	2.49±0.01
14	V14	0.15%	0.01%	3.88±0.01
15	V15	0.27%	0.01%	3.22±0.01
16	V16	0.16%	0.02%	2.68±0.01
17	V17	0.19%	0.01%	2.49±0.03
18	V18	0.08%	0.03%	3.10±0.01
19	V19	0.07%	0.00%	2.76±0.01
20	V20	0.14%	0.00%	2.66±0.01
21	V21	0.33%	0.02%	3.06±0.01
22	V22	0.01%	0.02%	3.22±0.00
23	V23	0.03%	0.02%	2.76±0.00
24	V24	0.10%	0.00%	3.00±0.01
25	V25	0.53%	0.02%	2.71±0.01

Vinegar of Modena with 0.021% while the lowest is Ikhwan artificial synthetic vinegar with 0.0002% and Wan Ja Shan rice vinegar with 0.0002%.

### 3.4 Analysis of the contents of ethanol

Alcohol is an organic substance that is formed when hydroxyl group is substituted for a hydrogen atom in a hydrocarbon, it is an intoxicating liquid found in liquor (Baharom, 2007), and this liquid is commonly referred to as ethanol which is the main alcohol content contained in alcoholic beverages, produced through the process of fermentation of sugar by using yeast. Ethanol is a

chemical liquefaction that can cause diffusion, the structure of the ethanol formula is  $C_2H_5OH$ . Ethanol is produced through fermentation; it is used in intoxicating beverages as well as for industrial purposes by mixing gasoline to make gasohol called ethyl alcohol or grain alcohol (Solar Energy Research Institute, 1982). Alcohol is one of the most controversial topic debated among Muslims as it is one of the things that are prohibited in the Qur'an (Bonne and Verbeke, 2008), alcohol is often referred to as *khamr* which is banned in Islam, but the term alcohol is also often used when referring to the functional group of alcohol, one of which is ethanol; a major psychoactive component in alcoholic beverages. It

is a component that comes naturally in fruits and fermented products such as vinegar (Najiha and Wan Nadiah, 2014). Therefore, there is a contradiction between *fuqaha'* regarding its function. Some scholars allow ethanol to be used in food processing based on the concept of *'umūm al-balwā* (widespread affliction that virtually difficult to avoid) which is a difficult test to eliminate or could not be prevented (Abd Razak and Ramli, 2018) but others argue that ethanol status is the same as *khamr* that is prohibited to be used by the Muslims (Ab Ghani and Ismail, 2010). However, too little ethanol content is permissible as additives to foods used as dyes, preservatives, emulsifiers and anti-acid based on *al-istihlak* concepts which negate the small percentage of *najs* with the amount of clean and pure dominant material within a product (Fiqh-Medical Seminar, 1997).

In the view of Islam, alcohol is a liquid that is forbidden to be used by Muslims without any purpose and reasonable reason for being harmful to health because alcohol can also lead to something bad because it can eliminate mindfulness and sensible reasoning and eliminating sanity that can be categorized as *khamr* things that are illegal and prohibited in Islam (Al-San'ānī, 2016). Although, each alcoholic beverage contains alcohol, but not all alcohol is illegal (*ḥarām*). Alcohol obtained from the process of winemaking is illegal and unclean while the alcohol obtained not through the process of making alcoholic beverages is permitted, but it is not permitted to consume in its original form because it is harmful. Therefore, any form of soft drinks made with no intentions to produce alcohol or contains alcohol under 1% v/v level can be consumed, while soft drinks made with the intention of making wine and produced the same way in winemaking, either containing a small or a little alcohol or distilled alcohol is illegal (*ḥarām*) (JAKIM, 2015). In this case, JAKIM has determined that the content of alcohol in any kind of soft drink must comply with the prescribed standards which is not to exceed 1% v/v while for food or drinks that contain flavoring or dye that contain alcohol for the purpose of stabilization is permissible to be used if the alcohol is not produced from the process of making wine and the quantity of alcohol in the final product must not be intoxicating and the content must not exceed 0.5% (JAKIM, 2015).

Fundamentally, the determination of the halal of vinegar is not specifically mentioned in the food law (diet law) and fatwa. It was never mentioned clearly about the percentage of the alcohol content. The Food Regulations 1985 only stated that vinegar, in general, must be the liquid result prepared from the fermentation of the alcohol and followed by the fermentation of the

acetate of any suitable food, vinegar shall also contain not less than 4% volume for each acetic acid weight and shall not contain any mineral acid. The determination of alcohol content is only stated in the Food Regulations 1985 which is in regulation number 361 (1). The general standards for alcoholic drinks are as follows:

"Alcoholic beverages must consist of liquors containing more than 2 per cent of volume for each volume of alcohol and include standard food prescribed in the following regulations: 362 to 384, 386 and 386A but not including litigation spirits or any liquor or any preparations containing more than 2 percent volume of each recognized volume of alcohol has a change in nature".

Apart from that, the resolution of alcohol content is also stated in a fatwa that has been decided by the Muzakarah of the National Council for Islamic Religious Affairs of Malaysia on the issue of Alcohol in Food, Drinks, Fragrances and Medicines (2011). The fatwa states:

"Soft drinks that are processed or made with not intended to produce alcohol and have alcohol under 1% v/v should be (can be) consumed, while soft drinks made with the intention of making wine and have similar process of making wine, either contain more or fewer alcohol or distilled alcohol is illegal to drink. Food or beverages containing flavors or dyes containing alcohol for stabilization purposes is permitted if the alcohol is not produced by the process of winemaking and the quantity of alcohol in the final product is not intoxicating and the alcohol content does not exceed 0.5%".

Food Regulations 1985 and the Muzakarah of the National Council for Fatwa Committee for Islamic Religious Affairs did not specify the specific content of alcohol allowed in vinegar, although the Muzakarah of the National Council for Fatwa Committee for Islamic Religious Affairs had decided on the vinegar resolution on the 76<sup>th</sup> muzakarah. However, the fatwa did not specify the permissible alcohol content in vinegar.

In the absence of resolution on the permitted alcohol in vinegar products, it is difficult to classify vinegar from *ḥalāl* to *ḥarām*. Therefore, the concept of *tahawwul* can be used as an alternative determination of the law or *ḥukm* of vinegar by looking at the content of alcohol and acidic acids present in vinegar products. The results showed that each vinegar product contains ethanol with a different percentage of ethanol depending on the type of vinegar and its source. The study found that the percentage of alcohol in traditional vinegar and industry is different. The highest percentage of alcohol was found in the non-*ḥalāl* Palm Vinegar (1.9%), which is the highest alcohol content of all types of vinegar in



Malaysia. On the other hand, the highest percentage of alcohol in industrial vinegar is found in Vinigen Pineapple Vinegar with a non-*halāl* logo; which is 0.53.

### 3.5 Analysis of the contents pH

Vinegars are produced from cider, grapes or wine, sucrose, glucose, malt, or any sugar-containing material that can be converted by successive alcoholic and acetous fermentation. Petsiou *et al.* (2015) stated that vinegar is good for increased glucose uptake (Mitrou *et al.*, 2015) and improved insulin sensitivity. The pH value indicates the acid strength in substances including food and drinks (Underhill, 1989). pH value is important to categorize vinegar based on the acid strength. The lower the pH value shows high level of acidity. Acetic acid is the major acid in vinegar. Acetic acid gives the global standards of taste, distinguishes vinegar and specify minimum acidity levels for vinegar. pH scale is widely recognized measurement of the strength of an acid and base. The total acidity of vinegar is expressed as acetic acid. Acetic acid is one of the organic acid and a monocarboxylic acid. Acidification is an important factor to limit the growth of spoilage microorganisms in fermentation such study by Lingham *et al.* (2013) addition of citric acid and acetic acid each reduced the growth of Enterobacteriaceae. Because of acetic acid content and low pH, vinegar is used as a preservative for both domestic use and in the food industry

As depicted in Table 2, different vinegar sample have different pH value but the majority are between 2.5-3.0 except sample 12, the pH value is 1.82. All were in the right value of pH for vinegar which is from 2.00 to 3.50. It is expected that a faster reduction in pH will indicate a higher breakdown of the substrates, and concomitantly leading to a more rapid increase of ethanol content. Based on Table 2, sample 12 fulfil the statement with 0.47% and 0.029% of the highest alcohol and acetic acid content respectively. pH value reduced with the production of lactic acid during fermentation. Synthetic vinegar is a vinegar produced by using chemicals such as sample 3 and 4. Based on the pH result reported, the vinegar that chemically produced is less acidic with the one that produced from the natural sources in contra with Jamaludin *et al.* (2017) that synthetic is more acidic compared to vinegar from fruits. Vinegar from natural sources was less acidic however some same type of vinegar has significant different pH value might due to the process involved in the production of vinegar such as sample 17 and 18 both from date.

Based on this study, the analysis on 25 samples of vinegar found in the Malaysian market, the researcher found that the whole vinegar is classified as *halāl*, the

whole sample has surpassed the complete transformation process so that it does not leave any trace of alcohol except at the rate allowed by the National Fatwa Council of Malaysia, but there are two types of vinegar that are classified as illegal vinegar (*haram*) because the vinegar is still in the process of *takhammur* so it contains alcohol level that is not allowed by the *sharia* and Malaysia National Fatwa Council (Table 2). In this case, the vinegar is still in the process of *tahawwul fasīd* (uncomplete transformation) thus the resulting in illegal (*fasīd* vinegar). Therefore, it can be concluded that the vinegar found in the Malaysian market can be categorized into two main groups namely *halāl* vinegar and *haram* vinegar.

## 4. Conclusion

In conclusion, the product produced through the fermentation process takes a long period in ensuring that the product is produced in a state of *halālan tayyiban* and free from intoxicant alcohol. To determine the degradation of a product produced through the fermentation process, it is necessary to have a *shummūl* (comprehensive) concept from the beginning of the manufacturing process until the final product. The application of this *tahawwul* application can be used as an alternative source for determining the dehydration of a product especially the product produced through the fermentation process, this concept can contribute to some more accurate findings as any changes in the fermentation process will lead to the different legal status of a product. Hence, these findings can directly assist various parties involved in issuing illegal *halāl* law on the present day.

## Conflict of Interest

The authors declare no conflict of interest.

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