Food Research 6 (Suppl. 3) : 1 - 9 (2022)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

FULL PAPER

Forensic determination of ethanol in import and local prepared vinegar for halal in accordance with Shafi'i school of jurisprudence

[1, 2,]*Baharuddin, A.S., [3]Amin, N.S.M., [1]Ruskam, A. and [4]Yacob, A.R.

[1]*Faculty of Syariah and Law, Universiti Sains Islam Malaysia, 71800, Nilai, Negeri Sembilan*
[2]*Academy of Islamic Civillisation, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia*
[3]*School of Management, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia*
[4]*Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia*

Article history:
Received: 16 August 2022
Received in revised form: 26 September 2022
Accepted: 29 September 2022
Available Online: 31 December 2022

Keywords:
Ethanol,
Ultraviolet-visible spectrophotometer,
Infrared spectroscopy,
Shafi'i schools of jurisprudence,
Fermentation,
Halal Forensic

DOI:
https://doi.org/10.26656/fr.2017.6(S3).010

Abstract

The percentage of ethanol in food has raised controversy in Muslim society. Different countries have their standard for the permissibility of ethanol percentage in foods and drinks. Malaysian National Fatwa Committee only permitted below 1% of ethanol in food or drinks. Vinegar contains ethanol which resulted from an incomplete fermentation process. This study aimed to determine the ethanol content in vinegar and to compare modern processing and traditionally produced vinegar. The methods of processing vinegar and alcohol content were analysed based on Shafi'i schools of jurisprudence guidelines in producing vinegar. This study utilised two methods to obtain research data; laboratory analysis and interview. Laboratory analysis used Ultraviolet-Visible Spectrophotometer (UV-Vis) and Infrared Spectroscopy (IR) as the instrument of analysis. A total of ten random samples of imported and locally produced vinegar were analysed in this study. As for qualitative analysis, this study used content analysis through descriptive, deductive, and comparative analysis approaches. NVIVO 7.0 software program was used to help in analysing qualitative data. Results showed that the highest ethanol content was 3.21% in black vinegar while the lowest percentage of ethanol is in the traditionally produced *Nipah* vinegar, which was 1.70%. Interviews found that the traditional method used in the process of making traditional vinegar is in line with Shafii schools of jurisprudence's guidelines for producing vinegar. All samples analysed for ethanol content were above the borderline allowed by Malaysian National Fatwa Committee (1% v/v). Thus, this study suggested that permitted ethanol content standards for processed foods through fermentation methods be reviewed and improved.

1. Introduction

Recently the polemic of the halal status of food and drinking products has become serious. The manufacturing process of non-Halal products has spread across the country. Fake halal logo status, unauthorized company in using the halal logo and fake halal certificates are among the issues that are at stake (Baharuddin *et al.,* 2021; Fadzli *et al.*, 2021). In order to determine the halal status of a product, the ingredient and manufacturing process must be taken into consideration. A halal product must be assured with all shariah requirements at every phase of production, starting from farm to fork (Baharuddin *et al.*, 2022; Roslin *et al.*, 2022). However, it takes a lot of effort for the authority to control every process phase of food production because sometimes manufacturing a single product takes a long period. Misinformation and lack of research have affected the decision in determining the halal status of a product by Jabatan Kemajuan Islam Malaysia (JAKIM) - Department of Islamic Development Malaysia especially from the false and inaccurate information given on the process and ingredients (Consumers Association of Penang, 2006). It worsens when it comes from international food products. As halal status is always in doubt, vinegar is one of the tops on the list. One of its compositions is ethanol which is in the group of alcohol that is naturally produced from the fermentation process.

*Corresponding author.
Email: *ahmadsyukran@usim.edu.my*

eISSN: 2550-2166
Published by Rynnye Lyan Resources

Generally, all vinegar is subject to halal verification as there are certain strict guidelines to be complied with to determine the halal status of vinegar (Jamaludin *et al.,* 2016). However, there are concerns about the production procedure, ingredients, sources, and also alcohol percentage in vinegar that is allowed by the religious authority in Muslim countries such as Malaysia.

Shafii's school of jurisprudence opined that vinegar sourced from wine or alcoholic drinks is impure. Based on content analysis on *mu'tamad* (final) point of view in Shafii's school of jurisprudence, the guidelines for making vinegar are first to avoid any additive or ingredient to be added during the fermentation process. Secondly, it is permissible if the additive/added ingredient is taken out before the fermentation process ends. Thirdly, the fermented ingredient should not be stirred, heated or given any outside temperature, either coincidently or intentionally. Shafii's school said that this kind of human interference in the fermentation process is a kind of conduct towards intoxicants and it is prohibited (Banjari, 1989; al-Sharbini, 1994; al-Bayjuri, 1999).

Special Muzakarah of the National Council Fatwa Committee for Malaysia's Islamic Religious Affairs which deals with alcohol Issues in food, drinks, fragrances, and medicines 14th to 16th July 2011 have agreed to decide that soft drinks that are processed or made not to produce liquor and its alcohol content are under 1% v/v, then it is permissible to be consumed. Also, foods or drinks that contain added flavour or colouring that contains alcohol as a stabilizer are permissible if it is not produced from the process of making liquor and the alcohol percentage content in the final product is not more than 0.5%.

Infrared spectroscopy is a mathematical basis operation optical spectroscopy used to sort out the single absorption frequency of functional groups and a spectrum dispersed into different wavelengths (Beć *et al*., 2020). The infrared spectrum developed from the absorption of electromagnetic rays at a low frequency related to the vibration of chemical bonds inside molecules (Khan *et al.*, 2018). Meanwhile, Ultraviolet spectroscopy (UV-Vis) consists of the measurement of the wavelength and the wavelength range of the UV spectrum is from l0 nm to 380 nm while the wavelength range for Vis is between 380 nm and 780 nm (Rocha *et al*., 2018). The previous study shows that UV-Vis has been used widely in ethanol analysis for alcoholic drinks (Duangdeewong *et al*., 2022; He and Bayen, 2020). Power *et al.* (2020) and Martins *et al*. (2017) stated that UV-Vis spectrometry is a simple method capable to differentiate and confirm alcoholic drinks.

Hence, this study aimed to determine ethanol content in vinegar and to compare modern processing and traditionally produced vinegar to be in accordance with Shafii's school of jurisprudence which the Malaysian National Fatwa Committee holds the opinion and the related *fatwa*s.

2. Materials and methods

2.1 Laboratory test

2.1.1 Reagents

Ethanol 99.7% (C_2H_5OH) from Hayman Limited was diluted with distilled water in five different concentrations, double distilled water from Universiti Teknologi Malaysia (UTM) inorganic laboratory.

2.1.2 Instrument

The study used Ultraviolet-Visible Spectrophotometer (UV-Vis) from Shimadzu l60lPC model using the cell from cuvette type 1 cm in size. Infrared Spectroscopy (IR) from Perkin Elmer model with Spectrum v5.3.1 software with sample background was set in the range of 450 to 4000 cm^{-1}. The absorption value is taken at 266 nm.

2.1.3 Sample selection

Ten samples of vinegar were used in this research including traditional vinegar and manufactured vinegar. Details of substance, category and halal status are shown in Table 1.

2.1.4 Preparation

2.1.4.1 Preparation for standard ethanol calibration

The main objective of this research is to analyse the percentage of ethanol in vinegar. To build a calibration curve of ethanol concentration, different concentrations in the range of 2% (v/v) to 10% (v/v) of ethanol dilution were prepared through different labelled volumetric flasks. The solution was marked up with distilled water until it reaches the mark. Table 2 shows a series of ethanol concentrations in percentage. Five diluted ethanol standard samples from the concentration of between 2 and 10 % (v/v) were recorded at first. Ethanol volumes of 1.0 mL and 3.0 mL were recorded five times to get the linearity of calibration.

2.1.4.2 Sample preparation for ultraviolet-visible spectrophotometer (UV-Vis)

Firstly, each sample was filtered using a paper filter. The spectra of five standard ethanol samples that have been diluted with concentrations from 2 % (v/v) to 10 % (v/v) were recorded first using distilled water as a reference. Then, the spectra of ten types of vinegar

https://doi.org/10.26656/fr.2017.6(S3).010

Table 1. Vinegar samples and details of each sample

Vinegar Type	Substance	Category	Halal Status
Grape	(Organic grape) High density of grape wine, cooked grape wine	Imported vinegar from Italy	No halal status
Apple	Fermented apple juice	Imported vinegar from Australia	No halal status
Date	Date fruits	Imported vinegar from Syria	No halal status
Plum	Plum juice, fermented and added with fructose	Imported vinegar from Taiwan	Halal Taiwan
Rice	Rice and water	Imported vinegar from China	Halal China
Pineapple	Pineapple juice, vinegar and malt	Local vinegar from Kuala Lumpur	Halal JAKIM
Mulberry	Mulberry, vinegar and malt	Local vinegar from Kuala Lumpur	Halal JAKIM
Black	Wheat, rice and water	Local vinegar from Kuala Lumpur	Halal JAKIM
Synthetic	Acetic acid, water and caramel	Local vinegar from Selangor	Halal JAKIM
Nipah	Original palm juice of *Nipah*	Local vinegar from Pengkalan Chepa, Kelantan (traditionally manufactured)	Halal JAKIM

Table 2. Ethanol volume (99.7 %) needed in the preparation of standard ethanol dilution

Ethanol volume (v/v)	Volume needed (99.7%) (mL)
2	1.0
4	2.0
6	3.0
8	4.0
10	5.0

samples that were diluted by 5% of vinegar were recorded using the same reference. Every vinegar sample spectrum was recorded three times and the average peak height was collected.

2.1.4.3 Sample preparation for infrared spectroscopy

In this study, Infrared spectroscopy (IR) instruments were used to see the hydroxyl group (-OH) and also the carbonyl group (-CO) of vinegar. This is because most of the vinegar contains acetic acid which belongs to the carboxylic acid group, which is a compound that has the chemical formula (-COOH) at the end (Chahardoli *et al*., 2020). The IR instrument used in this research is a Perkin Elmer model type with spectrum software version 5.3.1. The background for the sample is set in the range between 450 to 4000 cm^{-1}. A few drops of the filtered sample were placed on the NaCl disc and recorded. Scan button clicked on computers and the spectrum graph will appear on a computer screen.

2.2 Interview

The prior objective of the interviews was to obtain sufficient data on vinegar processing methods and factors that can affect the fermentation process. Observation is also made to approve and investigate the traditional method of processing vinegar. This research chose three respondents, all are from traditional vinegar entrepreneurs. Based on Janusheva *et al*. (2022), statistical sampling in a qualitative method is not a priority. This is due to purposive sampling which is more dominant and necessary in qualitative research. According to Längler *et al*. (2019), there is no definite answer on the sample size in any research due to the different types and patterns of research. Small size of samples is accepted when the demography of respondents is the same.

2.2.1 Instrumentation

The instrument of research was based on questions related to the demography of respondents, vinegar processing method and affecting factors in fermentation: Demography of respondent: Questions were based on the background of respondent; name, age, year of experience in producing vinegar, type of products produced and location of product commercialized.

Vinegar processing method: Questions were based on the vinegar processing method from the beginning of fermentation until the results of the fermentation process.

Factors affecting vinegar processing method: Questions asked to respondents about the processing place, temperature, period, and other related questions.

2.2.2 Interview protocol

Interview protocol is a guide in conducting the interview that helps to keep the interview on-track. Table 3 shows the interview protocol used in this study.

2.2.3 Interview data analysis

NVIVO software programme version 7.0 is used in analyzing unstructured data from interviews. NVIVO is a practical qualitative analysis software that is programmed to help organise qualitative data (Baharuddin, 2017). Data gained from the transcripts were transferred into NVIVO directly from the word (.docx) processor. Data obtained were then categorized into selected themes based on the interview protocol.

https://doi.org/10.26656/fr.2017.6(S3).010

Table 3. Interview protocol

Demography	I.	Could you please introduce yourself a little bit, your background, like name, age, experience in producing vinegar and your product type?
Vinegar processing method:	I.	How long does it take to produce vinegar?
	II.	Is there any change in the colour and smell of fermented liquid until vinegar is produced?
	III.	Is there any added ingredient during the fermentation process and when usually the ingredient added?
	IV.	If yes, what is it for?
	V.	What will happen if it is not added to the process?
Factors affecting fermentation:	I.	When does the fermented liquid become intoxicant and what is the characteristic at that time?
	II.	How does the fermentation been done? Is it left covered or uncovered?
	III.	How long can the fermented juice last when is not intoxicated when drank?
	IV.	Are there any outside factors that can affect the fermentation process, such as period, place, and temperature?

3. Results and discussion

3.1 Data analysis of the ethanol percentage from ultraviolet-visible spectroscopy (UV-Vis)

UV-Vis test is to determine the alcohol percentage in samples. Figure 1 shows the UV-Vis spectrum for standard ethanol solution. The percentage of ethanol concentration was determined by a curve in the graph built. The graph was plotted with the x-axis, as the percentage of ethanol concentration and the y-axis as the absorption of ethanol within the range of 0.02 (v/v) - 1.00 (v/v).

Figure 1 shows the UV-Vis spectrum for standard ethanol calibration. The absorption value is taken at 266 nm. Data transferred into the graph curve was plotted in Figure 2.

The regression equation of the calibration curve of ethanol taken at 266nm was y = 0.0921x – 0.2084 with correlation coefficients of 0.9622. Calibration was linear up to 10% for ethanol concentration. The results showed good accuracy and precision. Ethanol percentage in vinegar was determined from this curve and recorded in Table 4.

Table 4 shows UV-Vis data and the percentage of ethanol from the analysis. Grape and apple vinegar contain 2.20% and 2.45% of ethanol. Dates, plum and rice vinegar contain 2.31%, 2.96% and 2.65% of ethanol respectively. Black vinegar contains 3.21%, mulberry vinegar contains 2.74%, synthetic vinegar contains 1.98%, pineapple vinegar contains 2.81% and *Nipah* vinegar contains 1.70% of ethanol.

3.2 Data analysis of infrared spectroscopy

Infrared spectroscopy (IR) analysis is used to identify functional groups in vinegar. Vinegar contains acetic acid in large amounts besides water. The IR data for acetic acid and ethanol shows two spectra that differ in terms of spectral shape and also the wavelength value of the functional group bond. Although both have O-H chemical bonds, the range of wavelength values for both are different and can be identified in their respective spectra.

Acetic acid (CH_3COOH) is in the carboxyl (-COOH) group. The spectrum for carbonyl bond (C=O) is in the range of 1725-1665 cm^{-1}, while hydroxyl bond (O-H) is in the range of 3600-2500 cm^{-1} and C-O stretch is within the wavelength range of 1350-1210 cm^{-1} with middle intensity. The spectrum for acetic acid is shown in Figure

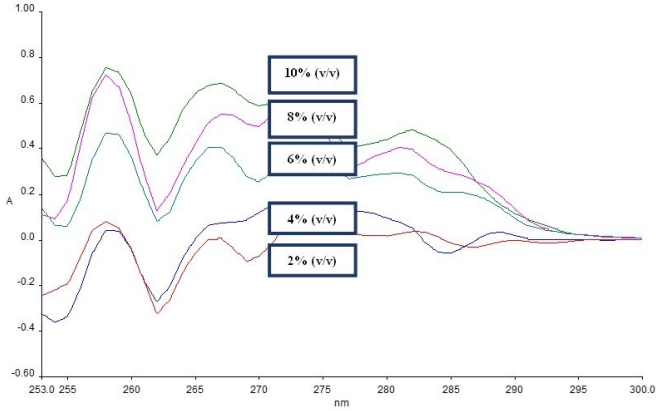

Figure 1. UV-Vis spectrum for standard ethanol solution

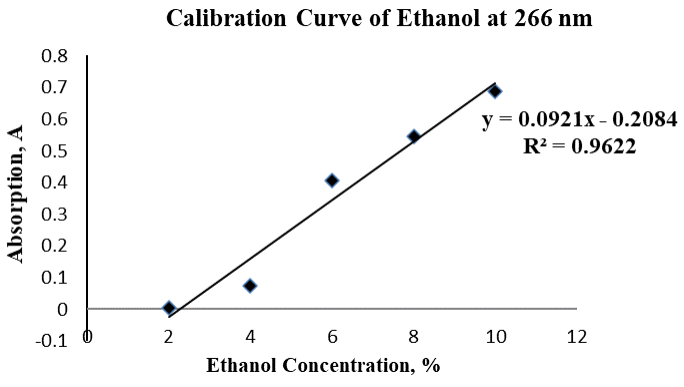

Figure 2. Calibration curve of ethanol at 266 nm

https://doi.org/10.26656/fr.2017.6(S3).010

Table 4. Ethanol percentage in vinegar

Vinegar Type	Halal Status	λ_{max} (reading 1)	λ_{max} (reading 2)	λ_{max} (reading 3)	Mean	Percentage (v/v)
Grape	No Halal logo	0.005	0.0054	0.0061	0.0055	2.20
Apple	No Halal logo	0.0185	0.0177	0.0182	0.0181	2.45
Dates	No Halal logo	0.0048	0.0052	0.0036	0.0045	2.31
Plum	Halal Taiwan	0.064	0.0632	0.0645	0.0639	2.96
Rice	Halal China	0.0363	0.0372	0.0346	0.0360	2.65
Black	Halal JAKIM	0.0872	0.0869	0.087	0.0870	3.21
Synthetic	Halal JAKIM	0.0253	0.0247	0.0261	0.0254	1.98
Pineapple	Halal JAKIM	0.0511	0.0497	0.0501	0.0503	2.81
Mulberry	Halal JAKIM	0.0443	0.0441	0.0452	0.0445	2.74
Nipah	Halal JAKIM	0.0518	0.0521	0.051	0.0516	1.70

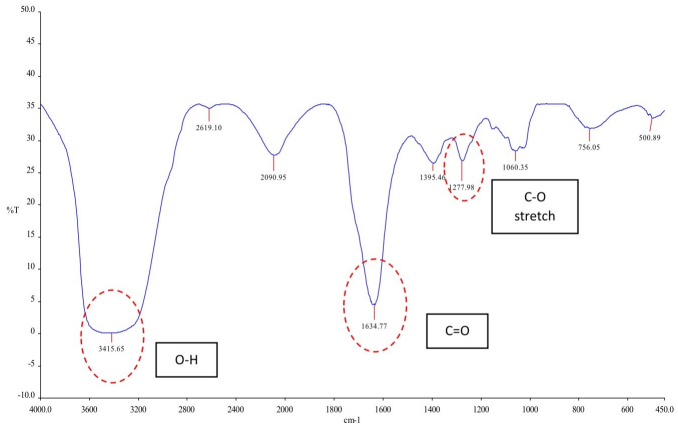

Figure 3. IR spectrum for acetic acid

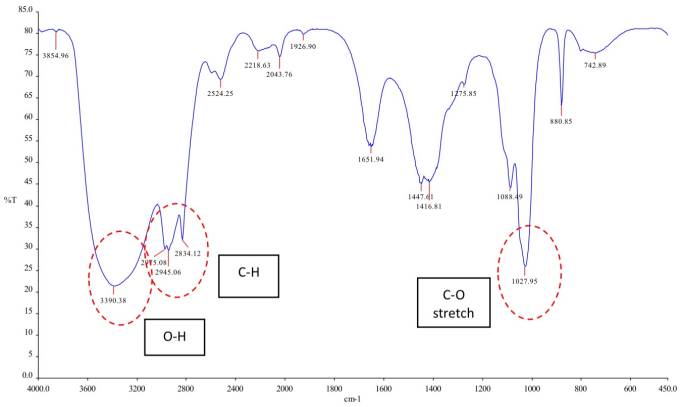

Figure 4. IR spectrum for ethanol

3. The spectra of acetic acid and wavelength of the O-H bond band are observed at 3415.65 cm^{-1} with strong intensity. For the double bond of carbon and oxygen (C=O) the wavelength is 1634.77 cm^{-1} and the C-O bond stretches at 1277.98 cm^{-1}.

While ethanol belongs to the alcohol group with the molecular formula CH_3CH_2OH. Alcohol compounds have hydrogen bonds (H-bonding). Spectra for O-H bonds (broad) are in the range of 3400-3200 cm^{-1}. C-O stretch is in the range of 1250-1000 and C-H (sp^3) is in the range of 2950-2850 cm^{-1}. Figure 4 shows spectra of ethanol with 99.7% concentration. As for the ethanol spectra, the wavelength of O-H is observed at 3390.38 cm^{-1} with strong and broad intensity. Meanwhile, at a wavelength of 2945.06 cm^{-1}, it shows the bond value for sp^3 C-H found in ethanol and the C-O stretch at a value of 1027.95 cm^{-1}.

Table 5 briefly shows IR data for ten vinegar samples. IR spectrum can be concisely shown in Figure 5. The spectrum shows the same functional group for every type of vinegar. Figure 5 shows the IR spectra of ten types of vinegar samples.

The results of this study show that there is still some ethanol left in the vinegar after the production process. The ten types of vinegar analyzed have an ethanol percentage range between 1 % to 4 % (v/v) of which the lowest % value is in *Nipah* vinegar, which is 1.70 % while the highest ethanol % value is found in black vinegar, which is 3.21 %.

As stated earlier, the percentage of ethanol allowed by the Malaysia National Fatwa Committee in food or drink must be between 0.5 % or a maximum of 1 % (v/v). Although this study shows that the percentage of ethanol found in vinegar exceeds the borderline set by the fatwa committee, however, the percentage of ethanol

Table 5. Concise IR spectrum data for ten types of vinegar

Functional Group	Wave peak (cm^{-1})										Remarks
	Dates Vinegar	Pineapple Vinegar	Apple Vinegar	Mulberry Vinegar	Plum Vinegar	Grape Vinegar	Rice Vinegar	Black Vinegar	Synthetic Vinegar	*Nipah* Vinegar	
Carbonyl	1638.00	1637.80	1633.44	1637.70	1634.50	1634.86	1638.10	1637.86	1638.28	1635.30	shows C=O bond
Hydroxyl	3448.10	3435.52	3423.62	3436.06	3433.57	3437.18	3423.42	3456.74	3428.03	3436.94	Shows hydrogen O-H bond

https://doi.org/10.26656/fr.2017.6(S3).010

found in the ten types of vinegar is still small in quantity when compared to the percentage of ethanol in other

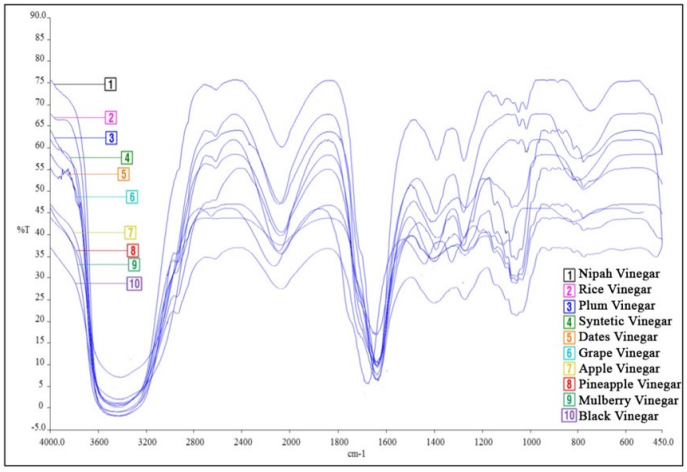

Figure 5. IR Spectrum for ten types of vinegar

foods that are processed through the same fermentation method (Kim *et al.*, 2022).

Ethanol in vinegar samples is instead above 1% (demarcation point allowed by Malaysian National Fatwa Committee), it is however produced naturally from the fermentation process. With that, it is in accordance with the fatwa that;

Food or drinks that contain natural alcohol such as fruits, beans, or cereals and their juice, or that alcohol produced from the manufacturing process of food or drinks is not *najis* (impure) and allowed (*halal*) to be eaten or drank.

Therefore, the determination of the halal status of food is not consistent if only looking at the ethanol content alone. This is because the percentage of ethanol found in most foods or drinks produced through traditional methods is above the fatwa's limit while the food or drinks can be eaten and do not cause intoxication.

Alcoholic beverages contain not only ethanol but many other components such as methanol, n-butanol, n-butanone, ethyl acetate, acetaldehyde, and others. The result of the combination of various components is what makes alcohol intoxicating and can cause addiction (Koob, 2021). However, there is no denying that ethanol is one of the ingredients that make alcoholic beverages intoxicating.

In addition, this study also found that the percentage of ethanol found in the vinegar sample is the remaining ethanol left over from the fermentation process. This refers to the theory of fermentation. There are two stages of the process, the first stage involves the process of converting sugar into ethanol by the yeast organism saccharomyces cerevisiae which acts to break down the sugar found in the extract or grain and produce carbon dioxide and ethanol. While the second stage involves the process of converting ethanol to acetic acid by the bacteria *Acetobacter acetii*.

When the fermentation process begins, there will be a process of decomposition of sugar to produce ethanol. The process of converting sugar to ethanol will continue until the sugar content is exhausted. As the ethanol content increases, the metabolic rate of the yeast will decrease.

Therefore, the ethanol found in the results of vinegar analysis is the ethanol formed during the fermentation process. The excess ethanol that remains is due to the incomplete conversion of ethanol to acetic acid. This coincides with the fatwa which is that food or drinks that contain alcohol naturally such as fruits, beans or grains and their extraction, or the alcohol that is contained incidentally during the process of making food or drinks are not impure and should (can) be eaten or drink.

Also, there were no big differences in ethanol percentage from laboratory tests on traditional vinegar and vinegar with and without the halal status logo. This result shows that the traditional method of processing vinegar and the modern method is not the only factor that affects the ethanol percentage in vinegar. Also, ethanol produced in vinegar depends on the amount of simple sugar in the food.

However, the ethanol percentage produced at the end of the manufacturing process could be controlled by various methods such as distillation. With that, the ethanol produced after the fermentation process in vinegar could not determine the halal status of the vinegar produced. Rather than the percentage of ethanol, the processing method of producing vinegar could be taken into consideration to match *syara'* guidelines.

Compared to other nations in Southeast Asia, there are dissimilarities between the countries on the demarcation point of ethanol acceptance in food and beverages. This is shown in Table 6. These dissimilarities are a consequence of the basis reference of ethanol content in the product, the method of ethanol detection, the undetermined value of intoxication threshold for blood alcohol content (BAC), and the Islamic worldview on Islamic jurisprudence principle of alcohol (Pauzi *et al.,* 2019).

Interview data were collected by interviewing traditional vinegar entrepreneurs in detail to provide supportive data for this study. According to Barret and Twycross (2018), it is one of the most useful methods for collecting data besides observation and relevant data documentation. Interviews found that every respondent

https://doi.org/10.26656/fr.2017.6(S3).010

Table 6. Dissimilarities of permissible ethanol content in halal dietary product in four countries (Pauzi *et al.*, 2019)

Countries	Demarcation points of ethanol allowed in halal dietary products	Type of ethanol
Malaysia	1% 0.5%	Naturally formed Industrial Ethanol
Singapore	Not stated Less than 0.5% additives, 0.1% remains in the final product	Naturally formed Industrial Ethanol
Indonesia	1% 1% for additives, but the final product must have 0.0% presence of ethanol	Naturally formed Industrial Ethanol
Brunei	2% Haram and prohibited even at a deficient volume that has no chance of causing intoxication and unnoticeable harmful effects	Naturally formed Industrial Ethanol

Table 7. Respondent's background and the vinegar production details in comparison with the modern method

Industry Name	Location	Experience	Type of vinegar produced	Traditional method used in production	Comparison with modern method
Pak Su Kemumin Enterprise	Pengkalan Chepa, Kelantan, Malaysia	More than 10 years	*Nipah* vinegar	• The incubation period is at least 40 days. • No added ingredients during the fermentation process • Fermentation process occurs naturally without heating/ stirring	• Incubation period can be reduced up to 13 days without reducing the quantity of vinegar • Yeast is added at first stage to promote starch conversion into ethanol. After day fourth, acetic acid bacteria are added to accelerate the conversion of ethanol to produce acetic acid • A venturi generator/pump is used to stir the extraction so that maximum aeration can be provided
Hisyam Nipah Enterprise	Sabak, Pengkalan Chepa, Kelantan, Malaysia	More than 10 years	*Nipah* vinegar		
Al-Ariff Enterprise	Bachok, Kelantan, Malaysia	More than 10 years	*Nipah* vinegar		

in Table 7 shares the same answer in explaining the traditional vinegar processing method. Table 7 shows the vinegar processing method from the fermentation period, added ingredients, and processing conditions explained by all respondents**.** All processing methods used by the entrepreneurs are in line with Shafi'i's guidelines for producing halal vinegar. On the other side of the table, there are brief explanations of modern methods of producing vinegar. Data analysis from interviews shows that traditionally processed vinegar is quite different from modern processed vinegar. The traditional processing method of vinegar ferments at least for 40 days without adding outside ingredients as catalysts for the fermentation process.

As compared to both methods, the traditional method of processing vinegar is in line with the guideline for making vinegar for Shafi'i school. This is due to the fermentation process that left itself to be naturally developed without adding any outside ingredient as a catalyst. Jurists from Shafi'i school considered this kind of method to be shari'ah compliant and the vinegar produced is halal and pure.

4. Conclusion

Laboratory analysis shows that ten vinegar samples analysed contain ethanol in a certain percentage including the traditionally manufactured vinegar. No big differences in ethanol percentage were found between traditional vinegar and vinegar with and without the halal status logo. Therefore, the amount of ethanol in vinegar cannot be only determined by the method used in producing vinegar. However, this study found strict principles in Shafi'i school of jurisprudence for producing vinegar that needs to be given consideration in determining the halal status of the product. Catalyst and additional methods to increase the rate of chemical reaction in the vinegar manufacturing process have their own guidelines in Shafi'i school of jurisprudence. It should be included in the guidelines for determining the halal status of vinegar. Hence, this study suggests that the Malaysian National Fatwa Committee review the current guidelines to avoid doubt and grey areas regarding the halal status of vinegar. This study also suggests more samples to be analysed using other methods in detecting ethanol in vinegar, and more respondents to be interviewed in the manufacturing process of vinegar in future research.

Conflict of interest

The authors declare no conflict of interest.

https://doi.org/10.26656/fr.2017.6(S3).010

Acknowledgements

This research is partially supported by USIM Research Grant: PPPI/FSU/0122/USIM/15322.

References

al-Bayjuri, I. (1999). Hasyiah As-Syeikh Ibrahim Al-Baijuri Ala Syairah Al-Alamah Ibnu Qasim Al-Ghazi Ala Matni As-Syeikh Abi Suja'. Beyrut: Dar Al-Kutub Al-Ilmiah.

al-Sharbini, S.A.-D.A.-K. (1994). Mughni al-Muhtaj ila Ma'rifat Ma'ani alfaz al-Minhaj. Beirut, Lubnan: Dar al-Kutub al-'Ilmiyyah.

Baharuddin, A.S., Wan Ismail, W.A.F., Abdul Mutalib, L., Hashim, H., Jusof, N., Mohd Ghazali, M.I., Alauddin, M.S. and Wan Harun, M.A. (2021). Halal Forensics Issues Involving Three-Dimensional (3D) Printing Technology of Cultured Meat. *ḤALĀL REVIEWS*, 1(1), 3–15. https://doi.org/10.55265/halalreviews.v1i1.7

Banjari, M.A. (1989). Sabil al-Muhtadin. Kuala Lumpur, Malaysia: Thinker's Library.

Barrett, D. and Twycross, A. (2018). Data collection in qualitative research. *Evidence-Based Nursing*, 21(3), 63-64. https://doi.org/10.1136/eb-2018-102939

Beć, K.B., Grabska, J. and Huck, C.W. (2020). Biomolecular and bioanalytical applications of infrared spectroscopy–A review. *Analytica Chimica Acta*, 1133, 150-177. https://doi.org/10.1016/j.aca.2020.04.015

Chahardoli, A., Jalilian, F., Memariani, Z., Farzaei, M.H. and Shokoohinia, Y. (2020). Analysis of organic acids. In *Recent Advances in Natural Products Analysis* (pp. 767-823). Elsevier. https://doi.org/10.1016/B978-0-12-816455-6.00026-3

Consumers Association of Penang. (2006). Halal Haram: Buku Penting Untuk Umat Islam. Pulau Pinang: Persatuan Pengguna Pulau Pinang. [In Bahasa Malaysia].

Fadzli, S.D.N.M., Harun, M.A.W., Baharuddin, A.S. and Adnan, M.R.A.R. (2021). Produk Makanan Ubah Suai Genetik (GMF) Dalam Perspektif Konsep Halalan Toyyiban Berdasarkan Penilaian Maqasid Hifz An Nafs. *Malaysian Journal of Syariah and Law*, 9(1), 73-85. https://doi.org/10.33102/mjsl.vol9no1.284

Hage, D.S. and Carr J.D. (2011). Analytical chemistry and quantitative analysis. New Jersey, USA: Prentice Hall Upper Saddle River.

He, N.X. and Bayen, S. (2020). An overview of chemical contaminants and other undesirable chemicals in alcoholic beverages and strategies for analysis. *Comprehensive Reviews in Food Science and Food Safety*, 19(6), 3916-3950. https://doi.org/10.1111/1541-4337.12649

Jamaludin, M.A. and Radzi, C.W.J.W.M. (2009). Teori istihalah menurut perspektif Islam dan sains: aplikasi terhadap beberapa penghasilan produk makanan. *Jurnal Syariah*, 17(1), 169-194.

Jamaludin, M.A., Hashim, D.M., Rahman, R.A., Ramli, M.A., Majid, M. Z.A., Othman, R. and Amin, A. (2016). Determination of permissible alcohol and vinegar in Shariah and scientific perspectives. *International Food Research Journal*, 23(6), 2737-2743.

Janusheva, V., Talevski, D.J. and Pejchinovska-Stojkovikj, M. (2022). Determining the sample in the language oriented qualitative researches. *Research in Pedagogy*, 12(1), 270-283. https://doi.org/10.5937/IstrPed2201270J

Khan, S.A., Khan, S.B., Khan, L.U., Farooq, A., Akhtar, K. and Asiri, A.M. (2018). Fourier transform infrared spectroscopy: fundamentals and application in functional groups and nanomaterials characterization. In *Handbook of materials characterization* (pp. 317-344). Springer, Cham. https://doi.org/10.1007/978-3-319-92955-2_9

Koob, G.F., Arends, M.A., McCracken, M. and Le Moal, M. (2021). *Alcohol: Neurobiology of Addiction* (Vol. 3). Academic Press.

Längler, M., Brouwer, J. and Gruber, H. (2019). Data collection for mixed method approaches in social network analysis. In *Mixed Methods Social Network Analysis* (pp. 25-37). Routledge. https://doi.org/10.4324/9780429056826-4

Martins, A.R., Talhavini, M., Vieira, M.L., Zacca, J.J. and Braga, J.W.B. (2017). Discrimination of whisky brands and counterfeit identification by UV–Vis spectroscopy and multivariate data analysis. *Food Chemistry*, 229, 142-151. https://doi.org/10.1016/j.foodchem.2017.02.024

Pauzi, N., Man, S., Nawawi, M.S.A.M. and Abu-Hussin, M.F. (2019). Ethanol standard in halal dietary product among Southeast Asian halal governing bodies. *Trends in Food Science and Technology*, 86, 375-380. https://doi.org/10.1016/j.tifs.2019.02.042

Power, A.C., Néill, C.N., Geoghegan, S., Currivan, S., Deasy, M. and Cozzolino, D. (2020). A brief history of whiskey adulteration and the role of spectroscopy combined with chemometrics in the detection of modern whiskey fraud. *Beverages*, 6(3), 49. https://doi.org/10.3390/beverages6030049

Rocha, F.S., Gomes, A.J., Lunardi, C.N., Kaliaguine, S. and Patience, G.S. (2018). Experimental methods in

chemical engineering: Ultraviolet visible spectroscopy—UV-Vis. *The Canadian Journal of Chemical Engineering*, 96(12), 2512-2517. https://doi.org/10.1002/cjce.23344

Roslin, U.H., Razali, M.F.A., Mohd Ghazali, M.I. and Baharuddin, A.S. (2022). Three-Dimensional (3D) Printed Food Products from Halal Forensic Perspective: A Preliminary Review. *Malaysian Journal of Syariah and Law*, 10(1), 54-62. https://doi.org/10.33102/mjsl.vol10no1.382

https://doi.org/10.26656/fr.2017.6(S3).010