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Tartaric Acid: An Analysis of Its Halal Status in Islamic Dietary Laws

Islamic Consumerism

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Asid Tartarik: Satu Analisis Status Halalnya dalam Hukum Pemakanan Islam

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ABSTRACT

This study examines the halal status of tartaric acid in Islamic dietary laws, focusing on four objectives: identifying sources, production methods, and effects; assessing ethanol content and intoxication potential; analysing the application of *istihalah* and *istihlak* principles; and establishing parameters for halal certification. The research employs a qualitative approach, utilizing library research to review fatwas, contemporary halal food science studies, and scientific literature on tartaric acid. Data analysis involves comparative, thematic, and interpretative techniques. Key findings reveal that tartaric acid's halal status is significantly influenced by its source and production method, with wine industry by-products being particularly contentious. While tartaric acid itself doesn't cause intoxication, potential ethanol contamination is a concern. The application of *istihalah* and *istihlak* principles in determining halal status is debated among Islamic scholars. The study establishes parameters for halal certification, including source, production method, ethanol content, and intended use. This research contributes to standardizing halal certification processes for tartaric acid and similar substances in the global halal food industry.

Keywords: Halal Certification, *Istihalah*, Islamic Dietary Laws, Tartaric Acid, Wine By-Products

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ABSTRAK

Kajian ini meneliti status halal asid tartarik dalam undang-undang pemakanan Islam, dengan memberi tumpuan kepada empat objektif: mengenal pasti sumber, kaedah pengeluaran, dan kesan; menilai kandungan etanol dan potensi memabukkan; menganalisis aplikasi prinsip istihalah dan istihlak; dan menetapkan parameter untuk pensijilan halal. Penyelidikan ini menggunakan pendekatan kualitatif, memanfaatkan penyelidikan perpustakaan untuk mengkaji fatwa, kajian sains makanan halal kontemporari, dan literatur saintifik mengenai asid tartarik. Analisis data melibatkan teknik perbandingan, tematik, dan interpretatif. Penemuan utama mendedahkan bahawa status halal asid tartarik dipengaruhi secara signifikan oleh sumber dan kaedah pengeluarannya, dengan produk sampingan industri wain menjadi isu yang sangat kontroversi. Walaupun asid tartarik sendiri tidak menyebabkan kemabukan, potensi pencemaran etanol menjadi kebimbangan. Aplikasi prinsip *istihalah* dan istihlak dalam menentukan status halal diperdebatkan di kalangan ulama Islam. Kajian ini menetapkan parameter untuk pensijilan halal, termasuk sumber, kaedah pengeluaran, kandungan etanol, dan tujuan penggunaan. Penyelidikan ini menyumbang kepada penyeragaman proses pensijilan halal untuk asid tartarik dan bahan-bahan serupa dalam industri makanan halal global.

Kata kunci: Asid Tartarik, Hukum Pemakanan Islam, *Istihalah*, Pensijilan Halal, Produk Sampingan Wain

INTRODUCTION

In Islamic jurisprudence, dietary laws are categorized into halal (permissible) and haram (prohibited), with the underlying objectives (*maqasid*) of promoting benefit (*maslahah*) and preventing harm (*mafsadah*) to individuals and society. Al-Qaradawi (1980) elucidates that, prohibitions in Islam stem from two primary rationales: *al-khabth* (impurity) and *al-darar* (harm). The prohibition of *al-khamr* (intoxicating beverages) exemplifies the latter, as it is predicated on the potential for *al-iskar* (intoxication), thereby aligning with the *Maqasid al-Shariah* of safeguarding human intellect.

The proscription of *al-khamr* is unequivocally established in both primary sources of Islamic law. The Quran states in Surah Al-Ma'idah:

> *O you who have believed, indeed, intoxicants, gambling, [sacrificing on] stone alters [to other than Allah], and divining arrows are but defilement from the work of Satan, so avoid it that you may be successful.*
>
> (Al-Ma'idah, 5: 90)

Furthermore, a hadith narrated by Muslim reinforces this prohibition:

كُلُّ مُسْكِرٍ خَمْرٌ، وَكُلُّ خَمْرٍ حَرَامٌ

Every intoxicant is khamr, and every khamr is haram.

(Sahih Muslim, Kitab: al-Ashribah, Bab: Bayan Anna Kulla Muskirin Khamrun, No. 2003)

In this context, the halal status of tartaric acid emerges as a pertinent issue, given its potential derivation from grape-based sources associated with wine production. This research endeavours to analyse the permissibility of tartaric acid within the framework of Islamic dietary laws, considering its origin, production methods, and potential for intoxication.

Research Problem

The halal status of tartaric acid in Islamic dietary laws presents a complex issue that intersects multiple principles of Islamic jurisprudence. Primarily, the concern revolves around the potential presence of ethanol and its capacity for *al-iskar* (intoxication), given tartaric acid's association with wine production. This necessitates a thorough examination of the substance's chemical properties and its effects on the human body.

Furthermore, the concepts of *al-isthalah* (transformation) and *al-istihlak* (dilution) come into play when considering the production processes and final composition of tartaric acid. These principles raise questions about whether the original substance undergoes sufficient change to alter its Islamic legal status.

Consequently, determining the ruling on tartaric acid requires a comprehensive analysis of these factors. This research aims to establish clear parameters and guidelines for assessing the permissibility of tartaric acid, considering its source, production methods, and potential for intoxication within the framework of Islamic dietary laws.

Research Objectives

This research aims to comprehensively analyse the halal status of tartaric acid within the framework of Islamic dietary laws. The following objectives have been formulated to guide this investigation:

i. What are the sources, production methods, and effects of tartaric acid in food and beverage applications?
ii. Does tartaric acid contain ethanol, and if so, does it have the potential for *al-iskar* (intoxication)?
iii. How do the principles of *al-istihalah* (transformation) and *al-istihlak* (dilution) apply to tartaric acid in determining its halal status?
iv. What parameters and guidelines should be established to rule on the halal status of tartaric acid?

Research Methodology

This study employs a qualitative approach, utilizing library research as the primary method for data collection and analysis. The research methodology is structured into two main components: data collection and data analysis.

Data collection involves a comprehensive review of various sources, including fatwas from reputable Islamic scholars and institutions, contemporary studies on halal food science, and scientific literature on tartaric acid. The research draws from academic databases, Islamic jurisprudence compilations, and published works on food chemistry and halal certification standards. This multi-faceted approach ensures a thorough examination of both the religious and scientific aspects of tartaric acid's halal status.

The data analysis phase employs several analytical techniques to synthesize and interpret the collected information. Comparative analysis is used to evaluate different scholarly opinions and scientific findings. Thematic analysis helps identify recurring concepts and issues across various sources. Interpretative analysis is applied to understand the context and implications of fatwas and scientific data. Deductive reasoning is utilized to draw conclusions based on established Islamic principles and scientific facts. Additionally, the research employs categorization to organize findings into relevant themes, and justification to support arguments with evidence from both Islamic and scientific perspectives.

LITERATURE REVIEW

This literature review synthesizes findings from various sources spanning scientific studies, halal certifications, and religious rulings on tartaric acid and its derivatives. The review covers the development of ideas surrounding tartaric acid's halal status, comparisons among studies, key research points, and identified research gaps.

Development of Idea

The discourse on tartaric acid's halal status has evolved significantly over the past two decades. Early research primarily focused on tartaric acid's chemical properties and industrial applications (Spiller et al., 2003; Aguiar et al., 2005). However, as halal certification gained prominence globally, attention shifted to the sourcing and processing of tartaric acid, particularly its potential derivation from wine industry by-products (Riaz & Chaudry, 2004; Islamicfoundation.ie, 2015).

Initially, many scholars and certification bodies categorized tartaric acid as "mushbooh" or questionable due to its association with wine production (Darul Iftaa Mahmudiyyah, 2009; Islamweb.net, 2012). However, as understanding of chemical processes improved, a more nuanced approach emerged. The concept of *istihalah* (transformation) began to play a crucial role in determining the halal status of tartaric acid and its derivatives (Majlis Fatwa Negeri Sabah, 2017; Jabatan Mufti Negeri Pulau Pinang, 2019).

Recent studies have expanded the scope of research to include the broader implications of tartaric acid use in various industries. Li et al. (2023) provided a comprehensive overview of grape tartaric acid's chemistry, function, metabolism, and regulation, highlighting its importance in wine production and potential for precise regulation. Concurrently, research has explored novel applications of tartaric acid

derivatives, such as their potential as antimicrobial agents in food packaging (Mikaelyan et al., 2024).

Comparison Among Studies

Scientific studies on tartaric acid have consistently demonstrated its importance in food and beverage industries, particularly in wine production (Spiller et al., 2003; Aguiar et al., 2005; Li et al., 2023). However, approaches to determining its halal status vary significantly among different scholars and certification bodies.

Some fatwa institutions, such as the Majlis Fatwa Negeri Sabah (2017) and Jabatan Mufti Negeri Pulau Pinang (2019), have taken a strict stance, declaring tartaric acid derived from wine lees as haram. In contrast, others like the National Independent Halaal Trust (2022) and Maulana Ubaidur Rahman (2024) have adopted a more permissive view, considering the transformation processes involved in tartaric acid production. Jabatan Mufti Negeri Selangor. (2024) states that tartaric acid not produced through the alcohol industry is permissible in food and beverage preparation.

Interestingly, geographical differences in tartaric acid production methods have led to varying halal certifications. For instance, the Halal Authority India (n.d.) states that tartaric acid produced in the USA is halal because it is obtained from unfermented grapes, while production methods in other countries may render it non-halal.

Research Keypoints

i. **Chemical Properties and Applications:** Tartaric acid is a dicarboxylic acid ($C_4H_6O_6$) naturally occurring in many fruits, especially grapes. It plays a crucial role in wine production and is widely used in food and beverage industries as an acidulant, flavour enhancer, and stabilizer (Li et al., 2023; Tochilina et al., 2023).

ii. **Production Methods:** Tartaric acid can be obtained from various sources, including grape by-products, tamarind pulp, and synthetic processes. The method of production significantly influences its halal status (Yalcin et al., 2009; Mulay et al., 2023).

iii. ***Istihalah* Concept:** The principle of *istihalah* (transformation) is central to determining the halal status of tartaric acid derived from wine by-products. Many scholars argue that if a complete chemical transformation occurs, the resulting product may be considered halal (Gültekin et al., 2020; Jabatan Mufti Negeri Perak, 2022).

iv. **Regulatory Perspectives:** Various halal certification bodies have issued guidelines on tartaric acid use. For example, the Indonesian Ulema Council (MUI) considers tartaric acid halal if it undergoes chemical reaction to form a new compound (Islamicfoundation.ie, 2015).

v. **Emerging Applications:** Recent research has explored novel uses of tartaric acid derivatives, including as antimicrobial agents in food packaging and potential health benefits in dietary supplements (Mikaelyan et al., 2022; Yousefi et al., 2023).

Research Gaps

Despite the extensive research on tartaric acid, several gaps remain in understanding its halal status and implications:

i. **Standardization of Halal Certification**: There is a lack of consensus among halal certification bodies regarding the criteria for determining the halal status of tartaric acid and its derivatives. This inconsistency creates confusion for manufacturers and consumers alike (Mariyam et al., 2022).

ii. **Traceability of Source Materials:** While the origin of tartaric acid significantly impacts its halal status, there is limited research on developing reliable methods to trace the source materials used in commercial tartaric acid production (Drieu et al., 2021).

iii. **Impact of Processing Methods:** More research is needed to understand how different processing methods affect the chemical composition and halal status of tartaric acid, particularly in the context of *istihalah* (Alias & Zabidi, 2021).

iv. **Consumer Awareness and Perception:** There is a dearth of studies examining consumer awareness and perceptions of tartaric acid and its halal status, which is crucial for informing policy decisions and industry practices (Mohamad et al., 2024).

v. **Alternatives to Wine-Derived Tartaric Acid:** While some studies have explored alternative sources of tartaric acid, there is a need for more comprehensive research on developing cost-effective and halal-certified alternatives to wine-derived tartaric acid for various industrial applications (Kurniadi & Frediansyah, 2016).

vi. **Long-term Health Effects:** Although tartaric acid is generally recognized as safe, there is limited research on the long-term health effects of consuming products containing tartaric acid and its derivatives, particularly in the context of halal dietary practices (Yousefi et al., 2023).

In conclusion, this research's comprehensive approach to analysing the halal status of tartaric acid, grounded in both scientific understanding and Islamic jurisprudence, has the potential to fill multiple identified research gaps. It can contribute significantly to the standardization of halal certification processes, improve traceability methods, enhance consumer awareness, and provide a model for evaluating similar substances in the global halal food industry.

DISCUSSION

This research discussion synthesizes findings from various sources to examine the halal status of tartaric acid in Islamic dietary laws, focusing on four key areas: the nature and production of tartaric acid, the issue of ethanol and intoxication, the concepts of *istihalah* and *istihlak*, and the rulings and guidelines surrounding tartaric acid's permissibility.

Tartaric Acid: Definition, Production and Effects

Tartaric acid (TA) is a dicarboxylic acid with the molecular formula C4H6O6, also known as 2,3-dihydroxy succinic acid or grape acid (Li et al., 2023). It occurs naturally in many fruits, particularly grapes, and is a fundamental constituent of wine, responsible for shaping its taste, aroma, and overall quality. In its unpurified form extracted from grapes, it exhibits its natural colour, while purified TA appears as a white crystalline powder (Li et al., 2023).

The production of tartaric acid can occur through various methods. Naturally, it is found in grapes and other fruits. Commercially, it is often obtained as a by-product of the wine industry (Yalcin et al., 2009). The waste samples from wine and grape juice industries contain significant amounts of tartaric acid, which can be extracted and purified. Yalcin et al. (2009) characterized these waste samples using various analytical techniques such as TG, DSC, FTIR, and XRD, and determined the tartaric acid content using HPLC.

Interestingly, the decomposition temperatures of waste samples were found to be relatively higher compared to pure tartaric acid, which was attributed to the presence of potassium tartrate (Yalcin et al., 2009). This finding highlights the complex nature of tartaric acid in its natural sources and the challenges involved in its extraction and purification.

The effects of tartaric acid are multifaceted. In the food and beverage industry, it serves as an important acidulant, flavour enhancer, and stabilizer. Its acidity is approximately 1.2 to 1.3 times higher than that of citric acid at the same concentration, making it an effective acidifying agent (Li et al., 2023). In wine production, tartaric acid contributes to the unique flavour and low pH of the wine, thereby determining its resistance to spoilage, microbial stability, and aging potential (Li et al., 2023).

Beyond its role in food and beverages, tartaric acid has shown potential health benefits. Spiller et al. (2003) conducted a study on the effects of tartaric acid from sun-dried raisins on colonic function and bile acid excretion in healthy adults. They found that tartaric acid, either from raisins or as cream of tartar, acted as a good stool softener and shortened intestinal transit time. Moreover, sun-dried raisins, which contain both tartaric acid and dietary fibre, showed potential benefits in decreasing the risk of colorectal cancer (Spiller et al., 2003).

Recent research has also explored novel applications of tartaric acid derivatives. Mikaelyan et al. (2022) investigated the antimicrobial properties of tartaric acid derivatives against phytopathogenic bacteria. They found that synthetic derivatives of tartaric acid demonstrated significant bactericidal and bacteriostatic activity against various multidrug-resistant strains of Gram-negative microorganisms. This opens potential applications in agriculture, horticulture, and food industry as alternatives to traditional antibiotics (Mikaelyan et al., 2022).

The Issue of Ethanol and *al-Iskār* (Intoxication)

The presence of ethanol in food products, particularly those derived from fermentation processes, poses a significant challenge in determining their halal status. This issue is particularly relevant to tartaric acid due to its association with wine production.

In the context of tartaric acid, this association with wine production is especially significant. Tartaric acid is a major organic acid found in grapes and is a key component in winemaking. During the fermentation process of wine, some of the tartaric acid remains unchanged, while ethanol is produced. This close relationship between tartaric acid and ethanol in wine production raises questions about the halal status of tartaric acid derived from wine industry by-products.

Ethanol, commonly referred to as alcohol, is produced during the fermentation of carbohydrates. In the context of Islamic dietary laws, the concept of *al-iskār* (intoxication) is crucial in determining the permissibility of substances containing ethanol. The prohibition of *al-khamr* (intoxicating beverages) in Islam is based on the principle of preventing harm (al-darar), specifically the intoxicating effect (*al-iskār*) that impairs the mind (Jamaludin et al., 2016).

For tartaric acid, the concern is not that it itself is intoxicating, but rather its potential contamination with ethanol when derived from wine industry sources. The challenge lies in determining whether the extraction and purification processes effectively remove all traces of ethanol, or if the remaining ethanol content is negligible enough to be considered halal.

However, the relationship between ethanol content and intoxication is not straightforward. Different countries and halal certification bodies have varying standards for permissible ethanol levels in food and beverages. For instance, the Malaysian National Fatwa Committee only permits ethanol levels below 1% in food or drinks (Baharuddin et al., 2022). In contrast, some scholars argue that any ethanol produced by anaerobic fermentation and ranging between 1% and 15% is considered haram (forbidden), whereas ethanol produced by natural fermentation and less than 1% is considered a preserving agent and its halal status is allowed (Alzeer & Hadeed, 2016).

These varying standards directly impact the halal certification of tartaric acid products. Depending on the jurisdiction and the specific scholar or certification body, tartaric

acid derived from wine by-products might be considered halal or haram based on its ethanol content, even if that content is extremely low.

The complexity of this issue is further illustrated by the study conducted by Alsaleem et al. (2022) on ethanol formation in fruit juices during refrigerated storage. They found that ethanol levels in all juices remained below 0.1% (v/v), which is the maximum residue level set by the GSO standard (2538:2017). This suggests that natural fermentation in properly stored fruit juices does not lead to significant ethanol production that would render them haram.

This finding has implications for tartaric acid sourced from fruit juices or similar processes. If tartaric acid can be extracted from fruit sources without exceeding this ethanol threshold, it may be more easily accepted as halal compared to tartaric acid derived from wine production.

The debate extends to products like vinegar, which contain ethanol resulting from incomplete fermentation processes. Baharuddin et al. (2022) analysed various vinegar samples and found ethanol contents ranging from 1.70% to 3.21%, all above the 1% threshold set by the Malaysian National Fatwa Committee. This highlights the need for a more nuanced approach to ethanol content in fermented products, considering factors such as production methods and intended use.

The case of vinegar provides an interesting parallel to tartaric acid. Both are products associated with wine or grape fermentation, and both can contain residual ethanol. The acceptance of vinegar as halal by many scholars, despite its ethanol content, could potentially inform discussions about the halal status of tartaric acid derived from similar sources.

The Issue of *al-Istihalah* (Transformation) and *al-Istihlak* (Dilution)

The concepts of *al-istihalah* (transformation) and *al-istihlak* (dilution) play crucial roles in determining the halal status of substances that undergo changes during processing or are mixed with other ingredients. These principles are particularly relevant to the discussion of tartaric acid, given its potential derivation from wine industry by-products.

The application of *istihalah* to tartaric acid production is a key point of debate. The extraction and purification processes used to obtain tartaric acid from wine lees involve significant chemical transformations. The question is whether these processes constitute a complete enough transformation to change the ruling on the resulting tartaric acid from haram to halal.

Al-istihalah refers to the complete transformation of a substance, changing its essential properties. In the context of Islamic jurisprudence, this concept is used to argue that if a prohibited substance undergoes a complete transformation, the resulting product may be considered halal. *Al-istihlak*, on the other hand, refers to the dissolution or dilution of

a prohibited substance to the point where it loses its original properties or becomes negligible in the final product.

For tartaric acid, the principle of *istihlak* could be applied if any remaining ethanol or other prohibited substances from the wine production process are diluted to such a degree that they become negligible in the final tartaric acid product.

There is significant debate among Islamic scholars regarding the application of these principles. The Hanafi, Maliki, and some contemporary scholars tend to apply *istihalah* more broadly, while the Shafi'i and Hanbali schools generally take a more restrictive approach (Mohamad, 2023). This difference in interpretation has led to varying rulings on the permissibility of substances derived from non-halal sources.

This scholarly debate directly impacts the rulings on tartaric acid. Scholars following the Hanafi or Maliki schools might be more inclined to accept tartaric acid derived from wine by-products as halal if they consider the extraction and purification processes as a form of *istihalah*. Conversely, scholars from the Shafi'i or Hanbali schools might be more likely to rule such tartaric acid as haram due to its origin, regardless of the transformations it undergoes.

In the case of tartaric acid derived from wine lees, the application of *istihalah* is particularly contentious. Some fatwa institutions, such as the Majlis Fatwa Negeri Sabah (2017) and Jabatan Mufti Negeri Pulau Pinang (2019), have ruled that tartaric acid from wine lees is haram because it is produced from fully fermented alcohol and the process of dealcoholisation through distillation does not occur naturally. However, other scholars and institutions, like the National Independent Halaal Trust (2022), argue that the chemical processes involved in extracting and purifying tartaric acid from wine lees constitute a form of *istihalah*, potentially rendering the final product halal.

The principle of *istihlak* is often applied to cases where small amounts of prohibited substances are mixed into larger quantities of halal ingredients. This concept is relevant to the discussion of ethanol content in food products. Some scholars argue that trace amounts of ethanol resulting from natural fermentation or used as a processing aid can be considered negligible if they do not lead to intoxication and are thoroughly mixed in the final product (Alzeer & Hadeed, 2016).

The application of *istihlak* to tartaric acid would involve considering whether any remaining prohibited substances from the wine production process are present in such small quantities that they become negligible in the final tartaric acid product. This could potentially allow for the acceptance of tartaric acid as halal even if it's derived from wine industry by-products, provided the concentration of prohibited substances is extremely low.

However, the application of *istihlak* is not universally accepted, particularly when it comes to substances explicitly prohibited in Islamic texts. The Shafi'i school, for instance,

tends to be more cautious in applying *istihlak*, especially to substances derived from pork or alcohol (Abubakar & Abubakar, 2021).

This cautious approach by some schools of thought presents a challenge for the acceptance of tartaric acid derived from wine by-products, even if the ethanol content is minimal. It suggests that for some scholars, the origin of the tartaric acid in wine production may be sufficient to render it haram, regardless of subsequent processing or dilution.

The debate surrounding *istihalah* and *istihlak* highlights the need for a comprehensive approach that considers both religious principles and scientific understanding. As Gültekin et al. (2020) argue, the evaluation of food additives in terms of *istihalah* should consider the chemical processes involved and the nature of the resulting compounds. This suggests that a more nuanced understanding of tartaric acid production and its chemical properties is necessary to make informed decisions about its halal status.

This call for a comprehensive approach is particularly relevant to tartaric acid. A thorough understanding of the chemical processes involved in extracting and purifying tartaric acid from wine by-products, as well as detailed analysis of the final product's composition, could provide valuable scientific data to inform religious rulings. This might include studying the molecular structure of the tartaric acid before and after processing, analysing for any residual ethanol or other wine-derived compounds, and comparing the properties of tartaric acid from wine by-products with tartaric acid from other sources.

The Ruling, Its Parameters and Guidelines

The ruling on the halal status of tartaric acid is complex and varies depending on its source, production method, and the juristic approach applied. This complexity is reflected in the diverse opinions and guidelines issued by various Islamic scholars and halal certification bodies.

Many scholars and institutions consider tartaric acid to be halal if it is not derived from wine or alcoholic sources. For instance, Mufti Abubakr Karolia (2005) stated that "Tartaric acid (dihydroxy-succinic acid), if not made/derived from wine, is Halal." Similarly, the Halal Authority India (n.d.) declares tartaric acid halal "if it is not obtained from wine by-product," noting that in the USA, it is considered halal because it is obtained from unfermented grapes.

However, the issue becomes more complex when considering tartaric acid derived from wine industry by-products. The Majelis Ulama Indonesia (2008) provided general guidelines stating that "By products of alcoholic drink industry and their derivatives are haram if they are only physically separated from the product but if they are chemically reacted to be a new compound, they become halal." This opens the possibility for tartaric acid derived from wine lees to be considered halal if it undergoes significant chemical transformation during the extraction and purification process.

The concept of *istihalah* (transformation) plays a crucial role in these rulings. The Jabatan Mufti Negeri Perak (2022) stated that tartaric acid is permissible to be used in the food industry if "Natural *istihalah* (transformation) has occurred during the wine processing." This suggests that the chemical processes involved in extracting and purifying tartaric acid from wine lees could potentially render it halal.

However, not all authorities accept this interpretation. The Majlis Fatwa Negeri Sabah (2017) ruled that "Tartaric acid that uses wine-lees is haram because it is produced from fully fermented alcohol and not before it becomes alcohol." They argue that the process of dealcoholisation through distillation of wine-lees does not occur naturally and is therefore not permissible.

The permissible ethanol content in food products containing tartaric acid is another point of contention. Different countries and certification bodies have set varying limits. For instance, the Malaysian National Fatwa Committee permits ethanol levels below 1% in food or drinks (Baharuddin et al., 2022), while some scholars argue for a more nuanced approach based on the source and purpose of the ethanol (Alzeer & Hadeed, 2016).

Considering these varying opinions, several parameters and guidelines have emerged for determining the halal status of tartaric acid:

i. **Source:** The origin of the tartaric acid is crucial. Tartaric acid naturally occurring in fruits or synthesized from non-alcoholic sources is generally considered halal.
ii. **Production method:** The process used to extract and purify tartaric acid is important, especially when derived from wine industry by-products. Chemical reactions that significantly transform the substance may be considered a form of istihalah by some scholars.
iii. **Ethanol content:** The final ethanol content in products containing tartaric acid should be below the threshold set by relevant authorities, typically ranging from 0.1% to 1%.
iv. **Intended use:** The purpose for which tartaric acid is used in food products (e.g., as a flavour enhancer, preservative, or acidity regulator) may affect its permissibility.
v. **Transformation (*Istihalah*):** The extent to which the original substance has been transformed during processing is a key consideration for many scholars.
vi. **Dilution (*Istihlak*):** In some cases, the principle of dilution may be applied if the tartaric acid or any prohibited substances are present in insignificant amounts in the final product.

In conclusion, the halal status of tartaric acid remains a complex issue that intersects religious principles, scientific understanding, and practical considerations. While there is general agreement that tartaric acid from non-alcoholic sources is halal, the status of tartaric acid derived from wine industry by-products is more contentious. The application of concepts like *istihalah* and *istihlak*, along with considerations of ethanol content and production methods, play crucial roles in determining permissibility.

As the global halal food industry continues to grow, there is an increasing need for standardized guidelines that balance religious requirements with scientific knowledge and practical realities of food production. Future research should focus on developing more precise methods for analysing the chemical transformations involved in tartaric acid production and their implications for Islamic dietary laws.

CONCLUSION

This research significantly contributes to the halal status discourse of tartaric acid by integrating religious principles, scientific understanding, and practical food industry considerations. It addresses the lack of standardization in halal certification by proposing clearer guidelines, focusing on *istihalah* and *istihlak* concepts for tartaric acid derived from wine by-products. The study bridges different Islamic schools of thought and emphasizes the need for precise scientific methods to analyse chemical transformations in tartaric acid production, aiming to provide a stronger scientific basis for religious rulings. This approach facilitates more consistent halal certifications and serves as a model for evaluating similar substances. The research potentially influences future certification processes and standards in the global halal food industry, contributing to the broader discussion on halal certification for food additives in a complex global food landscape.

This research, while comprehensive, has several limitations. It relies primarily on existing literature and fatwas, lacking direct experimental data on tartaric acid's chemical transformations during production processes. The study is also limited by the absence of consumer perspectives and industry practices regarding tartaric acid usage. Furthermore, the research does not address potential geographical variations in tartaric acid production methods and their impacts on halal status.

Future studies should focus on conducting experimental analyses of tartaric acid derived from various sources, particularly wine by-products, to provide empirical data on chemical transformations and residual ethanol content. Research on developing standardized methods for tracing tartaric acid sources in commercial products is needed. Additionally, studies exploring consumer awareness and perceptions of tartaric acid's halal status would be valuable. Investigating alternative, cost-effective sources of halal tartaric acid and examining the long-term health effects of tartaric acid consumption in the context of halal dietary practices are also important areas for future research.

This research on the halal status of tartaric acid in Islamic dietary laws yielded four key findings aligned with its objectives:

i. Firstly, tartaric acid's sources and production methods significantly influence its halal status, with commercial production often involving complex extraction processes from wine industry by-products. Its effects in food and beverages are multifaceted, serving as an acidulant, flavour enhancer, and stabilizer.
ii. Secondly, while tartaric acid itself doesn't cause intoxication, concerns arise about potential ethanol contamination when derived from wine by-products.

However, ethanol levels in properly processed tartaric acid are typically very low, often below the thresholds set by halal certification bodies.

iii. Thirdly, the principles of *al-istihalah* (transformation) and *al-istihlak* (dilution) are crucial in determining tartaric acid's halal status, but their application is debated among Islamic scholars. Some consider the chemical processes involved in purification as sufficient transformation to render the product halal, while others maintain a stricter view based on its origin.

iv. Lastly, the research established key parameters for determining halal status, including the source, production method, ethanol content, intended use, extent of transformation, and application of the dilution principle. However, these guidelines are not universally accepted, highlighting the need for standardized approaches in halal certification of tartaric acid.

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