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Exploring **Halal Value Chain** in the Global Context

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OVERVIEW
SELAYANG PANDANG

Journal of halal product and research (JHPR) is a journal published by Biannual (twice a year) by Halal Research Center and Product Development/ Pusat Riset dan Pengembangan Produk Halal (Halal Center) Universitas Airlangga, Surabaya, Indonesia (e-ISSN: 2654-9778 | p-ISSN:2654-9409). The journal is dedicated to improving the research and development of halal products. JHPR has been indexed by **Crossref**. All articles have unique **DOI numbers.** This journal publishes research from various topics in **halal studies and halal product development,** including: Chemistry; Biology; Food and Agriculture; Pharmacy, Medicine, and Pharmacognosy; Management, Business, and Finance; Behavioral science; Social science and Humaniora; and other related topics.

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Editorial

Exploring Halal Value Chain in the Global Context

Halal products as potentials to be developed by the industry in order to increase the competitiveness of products or services, and also institutions as a whole. Especially, faced with Muslim consumers. Global Islamic Economic Report (2020) estimates that Muslims spent $ 2.02 trillion in 2019 across the food, pharmaceutical, cosmetics, fashion, travel and media/recreation sectors, all of which are impacted by Islamic faith-inspired ethical consumption needs.

Therefore, the discussion about exploring the halal value chain in the global context as interesting theme. Thats can be encourage connectivity between supply and demand in everywhere and every time. In the long term, this is expected will be create a business matching scheme (domestically, regionally and globally) and it will provide good benefits for all stakeholders.

Journal of Halal Product and Research (JHPR) volume 3, issue 2, 2020 will discuss the part of the halal value chain, includes: operations, marketing, and technology. Even though it is partialy, we hope the scientific manuscript in JHPR can stimulate new ideas in research and development of halal products in the industrial world. The articles in this journal cover halal studies about: marketing studies, pharmaceutical, biology, and food product development. Author affiliations from Lovely University India, International Islamic University Malaysia, Airlangga University Indonesia, IAIN Syeikh Nurjati Cirebon Indonesia, and STIKES of Anwar Medika Hospital, Indonesia.

The editorial team express gratitude to the author and peer-reviewer, who had the pleasure to take their time and thoughts to this publication. Hopefully, the publication of JHPR can contribute in the knowledge dissemination to all parties.

Surabaya, 30 November 2020
Editorial board

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PROSPECTS OF BANGLADESH AS A HALAL TOURISM DESTINATION

PROSPEK BANGLADESH SEBAGAI DESTINASI PARIWISATA HALAL

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ABSTRACT

Halal tourism has opened a new horizon in the world tourism industry, both Muslim as well as many non-Muslim countries are showing their enthusiasm in Halal tourism. Bangladesh is the fourth largest Muslim populated country and the home of many Muslim architectures. Therefore, there is immense potential for Halal tourism in this country. The objectives of this study are to analyze the prospects of Bangladesh as a destination of Halal Tourism by identifying the strengths, weaknesses, opportunities, and threats (SWOT) of Halal tourism in Bangladesh. To meet the objectives of this research both qualitative and quantitative methods have been used. This study is a descriptive study with SWOT analysis. The majority of the data have been collected by the qualitative method from the existing literature and a survey on 93 people was conducted in the quantitative method. The result shows that Bangladesh is a promising country in the Halal tourism industry but it has some barriers too, which can be overcome by taking some effective initiatives on making a marketing strategy, arranging halal tourism campaigns to increase awareness, providing training for producing skilled manpower.

Keywords: Halal Tourism, Bangladesh, SWOT Analysis

ABSTRAK

Pariwisata halal telah membuka cakrawala baru dalam industri pariwisata dunia, baik negara Muslim maupun non-Muslim menunjukkan antusiasme mereka terhadap pariwisata halal. Bangladesh adalah negara berpenduduk Muslim terbesar keempat dan banyak arsitektur Muslim berasal dari negeri tersebut. Oleh karena itu, potensi wisata Halal di negeri ini sangat besar. Tujuan dari penelitian ini adalah menganalisis prospek Bangladesh sebagai destinasi pariwisata Halal dengan mengidentifikasi kekuatan, kelemahan, peluang, dan ancaman (SWOT) pariwisata Halal di Bangladesh. Penelitian ini menggunakan metode kualitatif dan kuantitatif. Pendekatan yang digunakan adalah analisis deskriptif dengan alat analisis berupa analisis SWOT. Data kualitatif diperoleh dari kajian pustaka, adapun data kuantitatif diperoleh melalui proses survei kepada 93 responden yang terkait. Hasil penelitian menunjukkan bahwa Bangladesh merupakan negara potensial dalam industri pariwisata halal, akan tetapi memiliki beberapa hambatan. Alternatif solusinya adalah mengambil beberapa inisiatif efektif dalam membuat strategi pemasaran, mengatur kampanye pariwisata halal untuk meningkatkan kesadaran, memberikan pelatihan untuk menghasilkan tenaga terampil.

Kata kunci: *Pariwisata halal, Bangladesh, Analisis SWOT.*

INTRODUCTION

The tourism industry has become a significant source of revenue for almost every country over the world. The direct contribution to the gross domestic product of the travel and tourism industry in 2017 amounted to $2.5% (3.2% of total GDP), according to the World Travel and Tourism Council and that statistic has been projected to grow to $3.8 trillion (3.6% of total GDP) by 2028 (Ainin, Feizollah, Anuar, & Abdullah, 2020). Halal tourism is one of the new forms of tourism which is expanding rapidly and it is considered as one of the fastest-growing segment of tourism, apart from the Muslim countries, many non-Islamic countries are showing their interest in Halal Tourism as well because of its progressive and flourishing market (Anowar & Abud, Prospects and Potentials of Halal Tourism Development in Bangladesh, 2018). Malaysia and Indonesia are holding the top position among OIC listed countries with 78 point on the other hand among non-OIC countries Singapore is holding the top position with 65 points in Global Muslim Travel Index (GMTI) 2019 (CrescentRating, 2019), another report of MasterCard and Crescent Rating (2019) by 2026, 230 million Muslim tourists would embark in tourism which would give a jab of $300 billion in the global economy. Because of the rapid progression of the Muslim travel market globally, it was assumed that by 2020 the Global Muslim travelers are expected to increase to 168 million (Addina, Santoso, & Sucipto, 2020) global valuation of the halal travel industry will rise to $233 billion (Rehman, 2019) and that shows the lucrativeness and optimistic sight of Halal Tourism in the world tourism market. Tourist behavior and attitudes and the overall activities of tourist are influenced by the demographic factors of a tourist (Rhama, Doddy, & Alam, 2017) and religious factors are considered one of demographic factors, Halal tourism package is tailored concerning the matter of Muslim traveler needs and demand which includes the Muslim friendly environment, accommodation, food as well as financial activities too (Rehman, 2019). However, with the growth in the emerging tendency of making holidays globally among the Muslim travelers to start exploring the globe due to the potential impacts for Halal tourism have been developed (Asad, Noriah, & Bader, 2016).

Bangladesh is a place of beautiful landscapes, although this country is small in size, it's been equipped with a variety of tourist destinations like hills, sea beaches, islands, heritage sites, biodiversity, and also a very vibrant and well-known for art and heritage (Islam, 2018). Bangladesh is a member of OIC (Organization of Islamic Cooperation) since 1974 and the world's 4th largest Muslim populated country, according to the report of World Population Review (2020) Bangladesh is the 8th largest country in terms of the number of population. Bangladesh is one of the members of the top 20 Muslim-friendly tourist destinations sharing 17th position in the GMTI list with having 56 points along with Lebanon and Algeria (CrescentRating & Mastercard, 2019). The Islamic vestige such as mosques, shrines, Muslim archaeological sites are found in every city in Bangladesh Country's capital Dhaka is called 'The City of Mosque' where around 5 million Muslim people gathered to pray each year (Anowar & Abud, Prospects and Potentials of Halal Tourism Development in Bangladesh, 2018) which is called 'Bishwa Ijtema', one of the largest Muslim's gathering after the Hajj in Mecca. So Bangladesh has a tremendous potential to develop as a Halal Tourist destination, though it is continuing the development but the development requires to be accomplished swiftly and precisely. The objective of this study is to analyze the prospects of Bangladesh as a Halal Tourism destination by identifying the strengths, weaknesses, opportunities, and threats of the potential of Halal tourism in Bangladesh.

LITERATURE REVIEW

Concept of Halal Tourism and Islamic Tourism

The terms Halal is an Arabic word which means lawful or permitted, According to the Islamic Council of Victoria (2020) Halal are those things which are free from any activities that are strictly forbidden to the Muslim according to the law of Islam called Sharia, another author Blackler et al., (2016) defined Halal are those things what are helpful but not harmful for Muslims. Halal is synonymous not only with foodstuffs but also with non-food products. These include beauty products, medical goods as well as leather accessories, perfumes, finance, leisure- pleasure, tourism, and transport services (Junaidi, 2020). Islam has a significant effect on the daily life of a Muslim also has an impact on their perception regarding tourism and travel. Due to the growth of Muslim populations globally Halal has become a key concern to the tourism stakeholders. Halal tourism is a form of tourism which is customized for Muslim tourist who follows the rules of Islam, Battour (2015) stated that Halal Tourism is any types of touristic activities which are grantable according to the law of Islam that are used by the Muslim in Tourism industry. Halal tourism is principally associated with Muslim oriented tourism, which is suitable for identifying Muslim desires, as per Islamic law, where sharia law would be followed by the tourist with

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the smoothed by the hosts of the destination, offering halal goods and services necessary for Muslim tourists (Asad, Noriah, & Bader, 2016)

Table 1: Concept of Halal Tourism

Source	Concept of Halal Tourism
(Ryan, 2016)	Halal tourism is to travel for leisure, pleasure, recreational and social purposes with keeping the faith in the Islamic religion.
(Gordana, 2014)	Halal tourism follows the rules of Sharia which determines the activities what is acceptable and what is unacceptable.
(El-Gohary, 2016)	Halal tourism is considered as a new concept which is associated with Halal and a subsection of religious tourism.
(Faulina, 2020)	Halal tourism is a blanket term which covers the activities and products of tourism

Suid et al., (2017) has reviewed the past literature where they have found that Muslim generally do practice two kinds of touristic activities; one is a pilgrimage which is called Hajj and Umrah held at Mecca and Medina, and another one is made with the combination of religious and leisure tourism which is mainly an altered touristic form of pilgrimage. In the present world, Islamic tourism has made its own address as a new tourist destination. 54 Islamic countries around the world are situated in different parts of the world and this tour is crossing its border and expanding its boundary (Anowar, Chamhuri, Shaharuddin, & Rabiul, 2011). The term Halal Tourism and Islamic Tourism are sounds similar but they both are different from each other and it's not defensible to use both terms at the same time (Rehman, 2019). For characterizing the phenomena in academia the term Halal Tourism is less briefly than Islamic Tourism (Erhan Boğan, 2017).

Table 2: Concept of Islamic Tourism

Source	Concept of Islamic Tourism
(Ryan, 2016)	"Islamic tourism" refers primarily to religious and pilgrimage-related travel and involves acts of faith related to the Islamic religion.
(Soydas, 2020)	Islam tourism is a tourism activity that is driven by most Muslims where touristic products are designed according to the rules of Islam
(Niyaz Gabdrakhmanov, 2016)	Islamic tourism is the result of a cross between hedonic tourism conception and real Qur'anic pilgrimage.
(Ahmad Yunus Mohd Noor, 2017)	Islamic tourism is not only about visiting religious places for pilgrimage but also it is an activity that has the goals and objectives to be accomplished in terms of physical, social, and spiritual goals

Religious belief affecting tourist behavior

According to World Population Review Bangladesh (2020) is a country which is having 165 million and out of them 89.1% are Muslims and rest of all are from others religion and the Muslim of Bangladesh has respect and belief on religion as well as they have a very good attachment with Islam (Huque & Akhter, 1987). Beliefs which are broadly received become a part of the culture and society which has a strong impact on behaviors, attitudes, and actions (Vajpayee 2016) and religion is a prime hub where the beliefs grow as religion influence to change the individual's behavior through positive and negative reinforcement. The religious belief of Muslim Bangladesh influence in domestic tourist behaviour and because of that people will be more attracted to follow the rules of Islam while travelling. After creating a good environment of Halal tourism by domestic tourist then it will be much easier to promote Bangladesh as a halal tourist destination.

Ratnasari et al., (2020) researched the emotional experience on the behavioral experiences and there they found that Halal certification of any food does not have any impact of customer satisfaction but it influences the behavioral intention of a customer and Shariff and Norenzayan (2011) conducted a research where they found People are more inclined to act in a virtuous or ethical way while they trust in frightening and punitive spiritual agents. Amat et al., (2014) conducted on research on 120 consumers

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on the perception towards purchasing halal food product where they found four factors which influence the perception of consumers and religious values are one of them. Religious belief has a strong interaction with Tourist behavior. Haddad et al., (2019) in their study explained individual behavior influenced by religious beliefs through the Theory of Planned Behaviour (Figure: 1) which is formed by attitude, subjective norms, and perceived behavior.

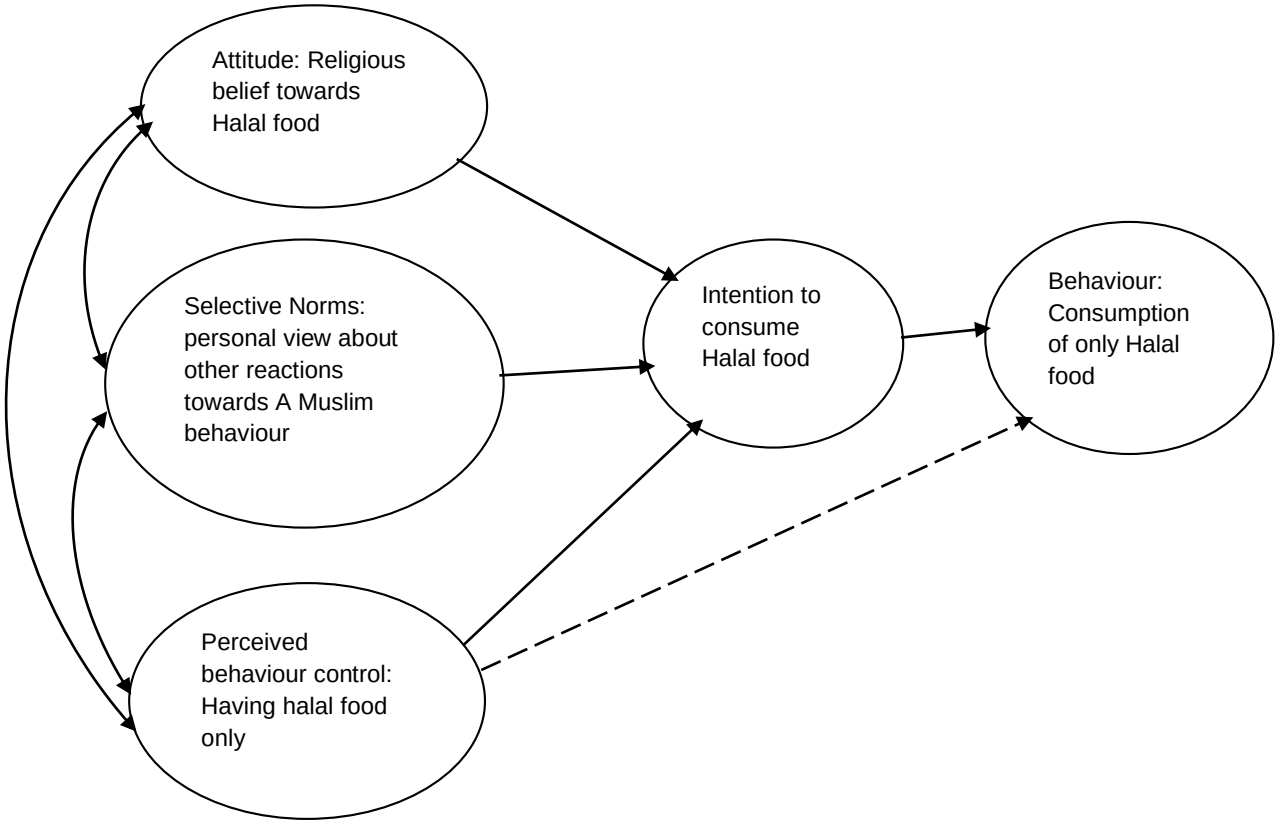

Figure 1: Halal food (Rafa, Salem, & Ayman, 2019) and Theory of Planned Behavior (Ajzen, 1991)

Demands of Muslim Travellers

Recently there has been a developing consciousness among the Muslims to choose halal options for their requirements from the general options which are offered currently that is why there some non-Islamic countries who are providing Muslim friendly environment to the Muslim tourists are facing some problems. In many country's Halal foods are provided by restaurants and prayer spaces have been allotted to the airport as well (Mohamed Battour M. N., 2014) (Ma'ruf, 1989) (National, 2014). Halal hotel, food, and Muslim-friendly airport, mobile apps are some basic requirements of a Muslim traveler (Rehman, 2019).

Halal hotel and food

Boğan (2020) defined Halal hotel as a hotel who is running its operation abide by the law of Islam and that types of the hotel can be called the sharia-compliant hotel, Muslim-friendly hotel, Islamic hotel, halal hotel in the global perspective, these types of the hotel can be called as conservative hotel, non-alcoholic hotel, halal-concept hotel, modest hotel, and Islamic hotel also (Dogan, 2008). Fatimazahra & Elhoussain (2019) have mentioned some characteristics of a Muslim friendly hotel in their paper, these are;

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Table 3 Characteristics of Muslim friendly hotel

Muslim-friendly hotel room should have:	Muslim-friendly hotel services include:
Right timetable for prayer	Verified Halal food/kitchens
Proper direction to Qibla	Excellently-trained staff about Muslim culture
Piece of the mat for prayer	Feminine staff for female
Right schedule for prayer	Separate floor for male/female/family
Pleasant family view	Different schedule for in swimming pool/gym for man and women
Water usage-friendly washroom	A particular place for prayer
Non-alcoholic beverages in the fridge	Amenities for Ramadan

Source: (Fatimazahra and Elhoussain 2019)

Muslim friendly airport

The airport is an important element for the tourism industry and while building an airport almost every Muslim country makes it Muslim friendly by keeping the place for prayers, catering halal food and with the increasing of Muslim outbound tourist many non-Muslim countries also making their airport Muslim friendly. Some Muslim friendly airports in non-OIC countries as follows;

Table 4 List of muslim friendly airport

Airports	Facilities for Halal Tourist
Changi International Airport, Singapore	Separate Muslim prayers room and wudu facilities for male and female, Halal dining
Tambo International Airport, Johannesburg	24/7 open Muslim prayers room, separate facilities for Jumu'ah salat (Friday Prayer) for male and female
London Heathrow Airport, UK	Muslim prayers room, facilities for Jumu'ah salat, Halal dining option
Colombo Bandaranaike International Airport, Sri Lanka	Separate Muslim prayers room for male and female
Munich "Franz Josef Strauss" Airport, Germany	Muslim prayers room with prayer rugs and copy of Quran
John F. Kennedy International Airport, New York	Separate prayer room for males and females, Jumu'ah Salat performed on every Friday and during Ramadan, dates, water and other snacks are provided for Iftar (Meal eaten during Ramadan by Muslims after sunset) in certain waiting areas
Melbourne Airport, Australia	Separate Muslim prayers room and wudu (ritual washing) facilities for male and female, Halal dining
Hong Kong Chep Lap Kok International Airport, China	A Halal-certified restaurant, Two Muslim prayer rooms, and wudu facilities
Manchester Airport, UK	Two 24/7 open multi-faith prayer rooms with wudu facilities, Provide religious dress changing facilities, and supply extra Irhams (special cloths wearing for Hajj purpose only) during Hajj
Suvarnabhumi International Airport, Bangkok	Muslim prayers room, facilities for Jumu'ah salat, Halal dining option
Narita International Airport (Japan)	Muslim prayers room

Source: (CrescentRating, Top 10 Halal Friendly Airports - Non OIC Countries)

Muslim friendly mobile apps

Finding a place where Halal food is served in a non-Muslim country is a difficult task (Rafa, Salem, & Ayman, 2019) and Melissa et al., (2003) conducted a research where they found due to the difficulties in finding Halal food in New Zealand the Muslim tourist used to cook their own food, that scenario will be same in almost every non-Muslim country, To get back from this issue Muslim tourists requires a Muslim a mobile app which is Muslim friendly and keeping it on concern Tourism Authority of Thailand has launched a Muslim friendly mobile app which will be used by the find out the hotels, restaurants, and shopping mall with prayer rooms and halal food (Reuters, 2015).

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METHODOLOGY

A mixed-mode method quantitative and qualitative method has been used to meet the objectives of this study. Qualitative method: The study is a descriptive study and the majority of the data was collected from the secondary sources which the base of this study and it includes the existing literature such as published journal article, newspaper, websites of Bangladesh tourism board, bureau of statistics and different annual reports of Muslim traveler. Quantitative method: Quantitative method refers to the primary data and it was collected by doing an online survey. The questionnaire was circulated through social media and got the respondents from different demographic profiles and those data have been analyzed by using MS Excel software.

The sample size and the population: The sample of this research has been taken from an online tour group of Bangladesh where people from different backgrounds exist. A questionnaire was circulated to 178 people who are a mainly frequent traveler and out of them 93 responses were received.

Table 5: Demographic profile of the respondents

Age		**Occupation**		**Level of Education**	
Below 25	52	Student	37	Graduation	26
25-40	30	Job	33	Post-graduation	46
40+	11	Others	23	Others	21
Total	93	Total	93	Total	93

DISCUSSION AND FINDINGS

Halal Tourism in Bangladesh

Tourism is a very blooming and promising industry for Bangladesh. Bangladesh is called the land of natural beauty and the home of the world largest sea beach named Cox's Bazar, the largest mangrove forest named Sundarban, Historic Mosque City of Bagerhat which is a UNESCO world heritage site, apart from these attractions this country has been blessed with many tourism resources. According to Anowar & Abud (2018), there are almost 1015 mentionable tourist destinations are available around the country. There is no particular concentration of tourist spots in Bangladesh rather than they are spread across the country. Table 6 represents the list of some renowned and most visited tourist places according to the division;

Table 6: List of tourist place in Bangladesh

Division	**Location**	**Tourist Place**
Dhaka	Capital City	Ahsan Manzil, Lalbagh Fort, Sonargoan, Bhawal National Park
Chattogram	Southern	Cox's Bazar, St. Martin Island, 3 hill districts (Bandarban, Rangamati, Khagrachari)
Rajshahi	Northern	Puthia Rajbari, Sompur Mahavihara, Mosthan Garh , Varendra Research Museum, Bagha Shahi Mosque, Choto Sona Masjid
Khulna	Southwest	Sundarban, Sixty Dome Mosque, Shilaidaha Kuthibari
Barishal	Southwest	Kuakata Sea Beach,
Sylhet	Northeast	Bichanakandi, Jaflong, Ratargul Swamp Forest, Tea garden, Madhobpur Lake
Rangpur	Northern	Tajhat Palace, Kantajew Temple
Mymensing	Northcentral	Shilpacharya Zainul Abedin Sangrahashala, Hasan Monzil, Modhutila Eco-park, Ghazni Leisure Center, Soshi Lodge, Birishiri

Source: (Bangladesh Tourism Board)

The government of Bangladesh formed a new unit of Bangladesh police called Bangladesh Tourist Police in 2009 with the provision to provide safety and security to the tourist (Bangladesh Tourist Police Official Website, 2020) as well as that unit has launched an app in 2017 called 'Hello Tourist' where the information regarding tourist places and the contact number and address of the police station is

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available. With the provision of providing safe and secure journeys BRTC (Bangladesh Road Transport Corporation) started operating buses for only women with the invigilation by CCTV in the capital city Dhaka (Sarkar, 2019) and ride-sharing app for women also available to provide a female-friendly ride. Halal tourism is a new horizon for Bangladesh that is why the government of Bangladesh has taken the initiative to preserve Islamic architecture as well which is an important part of Halal tourism, government has proposed a project of 1 cr. BDT for the preservation of Muslim archaeology in six places of Bangladesh (Moretaza, 2019). Bangladesh has a very well prospect in Halal tourism, Bangladesh is one of the top 20 countries on the Global Muslim Travel Index (GMTI) according to the GIEI (Global Islamic Economy Indicator) report (Table 7);

Table 7 GMTI report of Bangladesh

Destination	**2019 score**	**2019 rank**	**Enabling climate**	**Safety**	**Faith restrictions**
Bangladesh	56	19	21	85	100
Inbound economy	Restaurants	Prayer places	Airport	Unique experiences	Hotel
03	80	100	89	10	45
Ease of Communication	Digital Presence	Outreach	Connectivity	Visa Requirements	Transport Infrastructure
20	31	34	38	61	52

Source: (CrescentRating 2019)

Muslims all over the world want to have holidays in such environments that conform to their thoughts and satisfy their needs. These issues include the availability of halal food and places to perform prayer in hotels and restaurants as well as family-friendly facilities. Halal tourism is a very prospective sector for Bangladesh due to the availability of Halal foods and attractions. The government of Bangladesh has already moved forward to set up a certification board for halal foodstuff to ensure the food has been processed under the proper law of Islam. The demand for Halal food from Bangladesh is increasing by Muslims and non-Muslim countries which makes Bangladesh the fifth largest country in the world market for Halal foods and beverages (Bangladesh Post, 2019). Table 8 presents the data of Halal attractions where it is seen that there are approximately 205 mentionable halal attractions available in Bangladesh which is 20% of the total number of attractions and the Dhaka division has the highest number of halal attractions. Also, Dhaka is declared 'OIC Tourism City 2019' (Moretaza, 2019).

Table 8 Number Of Halal Attractions In Bangladesh

Division	**Mentionable Tourist Attractions**	**Halal Attractions**	**Percentage**
Dhaka	300	54	18%
Chittagong	133	24	18%
Rajshahi	128	34	27%
Khulna	160	38	24%
Barishal	74	16	22%
Sylhet	64	7	11%
Rangpur	106	20	19%
Mymensing	50	12	24%
Total	1015	205	20%

Source: (Anowar & Abud, Prospects and Potentials of Halal Tourism Development in Bangladesh, 2018)

The tourism industry has surpassed all other industries in the world already. Howlader (2019), said that tourism has a 2.2% direct contribution to Bangladesh's GDP which was expected to rise 8% by 2020. It has been assumed that the contribution of the tourism industry would be 3.24 million by 2032. Directly 1.18 million and indirectly 2.43 million people are involved with the tourism industry in Bangladesh currently and the number of the participants would be higher with the starting of offering Halal tourism packages to the tourist as it is a new segment of Tourism. The tour operator of Bangladesh can customize the Halal tourism packages (Halal honeymoon packages for a newly married couple) for inbound and domestic tourists as Bangladesh receives a smart amount of tourists from OIC countries.

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Table 9 shows the number of visitors' arrival from OIC countries where it is noticed that from 2006 to 2014, 270257 visitors have visited which is 13% of total visitors' number.

Table 9 List of tourist arrival

Year	No. of Tourists Arrival	No. of Arrivals from OIC Countries	Percentage
2006	200,311	46024	23%
2007	289,110	50291	17%
2008	467,332	19713	4%
2009	267,107	18618	7%
2010	303,000	19915	7%
2011	155,000	22220	14%
2012	125,000	26518	21%
2013	148,000	49238	33%
2014	125,000	17720	14%
Total	2,079,860	270257	13%

Source: (Anowar & Abud, Prospects and Potentials of Halal Tourism Development in Bangladesh, 2018); Adapted from Bangladesh Bureau of Statistics.

Halal tourism is a kind of tourism where it is important to do all kinds of touristic activities by following the rules or laws of Islam called Sharia as well but Bangladesh is a secular democratic country, although the majority follow Islam, Sharia law has not imposed here. The environment of most of the luxury hotels are not halal, separate floor, swimming pool, restaurants for man or women are not available and they are allowed to serve or sell alcoholic beverages, in section 13 of the Act, it is found that one can sell the alcoholic beverages by taking license from Director General of the Bangladesh Department of Narcotics Control (The Daily Star, 2019). As Bangladesh is very new in the Halal tourism market so it is tough to compete with a country like Malaysia, Indonesia, UAE who already holds the top position in the Halal market. Though many OIC countries, as well as non-Muslim countries, are making new policies, marketing strategies to promote Halal tourism for capturing the Halal Tourism market but in Bangladesh, there is no such kind of activity noticed. Very few tour operators are customizing Islamic tour package but the rest of the operators do not have skilled and trained staff to operate Halal Tourism as well as the term Halal is not familiar to the general people. For developing the halal tourism market all the stakeholders must be aware of what Halal tourism is, by quantifying the knowledge and awareness of the people of Bangladesh regarding Halal tourism it will be much easier to take initiatives by the government and the authority because more number of familiar people with knowing about Halal tourism will be resulting in less expenditure of government on providing education and training, organizing campaign for making people aware. A survey was performed among 93 people to observe whether they are familiar/unfamiliar with the term Halal. These 93 people are the most frequent tourist who travel more than 7 times in a year. The aim of this survey was to quantify the awareness of those people who closely related with tourism.

Table 10 Percentage of people familiar/unfamiliar with halal tourism

Total	**Familiar with Halal Tourism**		**Percentage of familiar and unfamiliar people**	
93 People = 100%	YES	NO	Familiar	Unfamiliar
	12	81	12.90323	87.0967
Total	93		100%	

Source: Field Survey

Analysis of Halal Tourism in Bangladesh

SWOT analysis is a framework that has been used to analyze the strengths, weaknesses, challenges, and threats of Halal tourism in Bangladesh for determining the country's prospects for Halal Tourism.

Strengths of Halal Tourism in Bangladesh

- Availability of Halal food, attractions, and amenities.
- Bangladesh is a land of natural beauty.
- Massive amount of Muslim inhabitants

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- Bangladeshi people are hospitable and love to welcome and assist the tourist.
- Received an enormous number of tourists from OIC countries.
- Subsidies from the government for the betterment of the Halal tourism industry.
- Tourist Police to ensure safety and security in the tourist place.

Weaknesses (challlange) for Halal Tourism in Bangladesh

- Lack of proper knowledge regarding halal tourism to the common people and the stakeholder of tourism as well.
- Poor marketing strategy for Halal tourism.
- Insufficiency of well trained and skilled manpower to run Halal tourism.
- The elegant hotels are permitted to serve alcoholic beverages and no separate pool area available for males and females that is why it is a little bit tough to provide a halal-friendly environment.

Opportunities for Halal Tourism in Bangladesh:

- Promoting Halal tourism within the border and outside the border (Halal Honeymoon Packages).
- Positive outlook in the world as a Muslim country.
- Making people aware of Halal tourism by providing bookish and practical knowledge.
- The halal tourism industry will create many employment opportunities.
- Positive image as a Muslim country

Threats of Halal Tourism in Bangladesh:

- Halal tourists are more interested in well-established Halal Tourism destination like Malaysia, Indonesia
- No specific policies or regulations have been formed for Halal tourism
- Lack of branding Bangladesh as a tourist destination

Bangladesh is very new in the halal tourism market and the availability of halal food & attractions, receiving a large number of Muslim tourist, numerous Muslim inhabitants, and government support by financially and ensuing security make Bangladesh more potential in Halal tourism but the unavailability of skilled manpower, lack of awareness and knowledge of the stakeholders, absence of branding and marketing strategy are pulling the halal tourism industry down and some effective initiatives such as providing training, education, arranging halal tourism campaign can help to develop the halal tourism destination and establish as a halal tourism destination.

CONCLUSION

Halal tourism has become one of the fastest-growing segments in the global tourism industry, both Muslim and non-Muslim countries are showing their interest in Halal tourism for its prosperous and promising future. Despite having a huge opportunity in Halal tourism because of Muslim infrastructures, Halal food, Muslim friendly environment, Bangladesh has not been able to attract the attention of the world yet in the Halal tourism sector due to some reasons. The masses of this country are not much aware of the advantage and prospects of halal tourism and there is an insufficiency of trained and skilled staff to operate and design Halal tourism. However, it is very possible to solve these problems and established Bangladesh as a Halal tourist destination but for that the government along with the stakeholders must take initiatives on making the masses aware of Halal tourism, formulating proper Halal tourism policy, branding, highlighting, and promoting Halal tourism to get the best outcome.

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Journal of Halal Product and Research

DETERMINANTS AFFECTING PURCHASE INTENTION OF HALAL PRODUCTS: AN ARTICLE REVIEW

FAKTOR-FAKTOR YANG MEMPENGARUHI MINAT BELI PRODUK HALAL: ULASAN

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ABSTRACT

This study's main objectives are to analyze the literature related to the factors influencing halal products' purchase intention and identify the literature gap for future study recommendations. The researchers evaluate the numerous assessed studies conducted in different countries. Halal products' major determinants in purchase intention are attitude, subjective norm, perceived behaviour control religiosity, halal awareness, and halal certification. Researchers have not examined factors such as price, exposure, place, halal supply chain, and advertising in their studies. Common theories used in previous literature are the Theory of Planned Behavior (TPB). One of the gaps for further research on halal products' purchase intention is the lack of research in the halal pharmaceutical, halal fashion, halal tourism, halal supply chain, and halal finance fields. In the future, the researcher may apply other theories that can be used to study purchase intention, such as theory consumption value or theory diffusion of innovation.

Keywords: Halal Products, Halal, Purchase Intention Determinants

ABSTRAK

Tujuan utama penelitian ini adalah untuk melakukan analisis kepustakaan terkait faktor-faktor yang mempengaruhi minat beli produk halal dan mengidentifikasi kesenjangan pustaka agar dapat memberikan rekomendasi pada penelitian selanjutnya. Para peneliti mengevaluasi beragam studi yang telah dilakukan di berbagai negara. Penentu utama produk halal dalam minat beli adalah sikap, norma subjektif, religiositas yang dipersepsikan sebagai kontrol perilaku, kesadaran halal, dan sertifikasi halal. Peneliti belum meneliti faktor-faktor seperti harga, keterpaparan, tempat, rantai pasokan halal, dan periklanan dalam studi mereka. Teori yang umum digunakan dalam penelitian sebelumnya adalah Theory of Planned Behavior (TPB). Salah satu kesenjangan penelitian yang perlu dipertimbangkan untuk penelitian minat beli produk halal di masa mendatang adalah kurangnya penelitian di bidang farmasi halal, fashion halal, wisata halal, rantai pasok halal, dan keuangan halal. Pada studi selanjutnya, peneliti dapat menerapkan teori lain untuk mempelajari minat beli, seperti teori nilai konsumsi atau teori difusi inovasi.

Kata kunci: *Produk halal, halal, faktor-faktor penentu minat beli*

INTRODUCTION

Nowadays, almost one-third of the world's inhabitants are Muslims. This number is increasing at 1.84%, from 2.14 billion in 2018 to 2.25 billion in 2019 (Population, 2020). The rapid growth of the Muslim population worldwide is the fundamental cause of the global halal industry's expansion. To elucidate, Halal means lawful or allowed. Halal products are products prepared following Islamic law, also known as Sharia law or Islamic law, in compliance with acceptable processes or procedures (Nur Famiza et al., 2017). Halal's theory is based on the Quran (Muslim Holy Book) and Sunnah (Prophet Muhammad's normal practices). Halal products are widely used for food, meat, cosmetics, personal care products, pharmaceutical, food ingredients, and contact with food materials (ICV, 2019). As a Muslim, consumption of Halal products is an obligation, as stated in the Qur'an,

"*And eat the lawful and good food (thayib) from that which has been granted to you and fear Allah and believe in Him*" (Al Maidah 5: 88).

The Halal markets, especially food, have received positive responses because their qualities have covered the fundamental aspects of hygiene, safety, health, and quality. Thomson Reuters (2020) stated that the global Muslim spending across lifestyle industries as follows, the Islamic finance industry has US$ 2.88 trillion in total assets. Food and beverage lead Muslim spending by segment to US$ 1.17 trillion. Apparel and clothes to US$ 277 billion, media and entertainment to US$ 222 billion, travel to US$ 194 billion, and pharmaceutical and cosmetics to US$ 94 billion and US$ 66 billion, respectively. The Halal market is expected to continue growing in the coming years.

Given that Halal products' demand is expected to increase in the coming years, the determinants affecting purchase intention towards Halal products need to be studied to facilitate market growth. The purpose of this review article is twofold: first, to analyze the factors influencing halal products' purchase intention, and second, identifies literature gap for future studies recommendations. The findings could become inputs to the Halal manufacturers to recognize and target the Halal products' consumers, understand their outlook, and the factors that influence their intention in purchasing halal products. This study focuses on the purchase intention of multiple Halal products such as foods, meat, cosmetics, pharmaceutical, finance, tourism, and fashion sectors. Identification of gaps in the literature could also expedite the research and development of the Halal field.

METHODOLOGY

The approach used by Joshi & Rahman(2015) is adapted to achieve the objectives of the article. The approach used for this review article is as follows.

Scope

This study analyses the empirical research on consumer Halal purchase intention papers published in Scopus. It focuses only on studies that sought to identify and test the various factors affecting Halal purchase intention. Studies are obtained through an electronic search of the Scopus database. The Scopus database is selected to ensure that only high-quality research is included. Scopus database one of the largest bibliographic databases of peer-reviewed articles (Haleem et al., 2020).

Selection of Articles

Selection criteria Halal purchasing purpose requires a wide variety of consumption activities. This paper focuses only on studies that illustrate the various factors influencing consumers' intention to buy halal related products or services. The following selection criteria are adopted to select the related studies: (1) The article should be a research article (2) The research should address factors influencing the purchasing intention related to halal sectors.

Selection Process

Research papers are found through a systematic search method that includes searching for keywords in the title, abstract, and keyword portion of the Scopus database. The keyword used is "Halal Purchase Intention." The search resulted in 88 articles. In the next step, the papers' content is reviewed by cross-checking the abstracts to ensure that the database contained only the correct articles for analysis, just empirical research exploring different factors influencing customers' purchasing intention. The process contributed to the deletion of 43 articles. Next, all the papers are reviewed for replication, and one article is found to be duplicated. After the elimination process, 44 eligible papers are left for the final review.

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The selected articles are limited in number since only empirical articles related to the Halal purchase intention are included.

Analysis Approach

Full-text research articles have been extracted from the Scopus database. The entire content of a particular study is examined. It includes analysis and review of title, literature, conceptual background, methodology, results, discussions, implications, and future research directions. Table 1 shows the list of studies affecting halal purchase intention reviewed in this article.

Table 1 List of studies affecting halal purchase intention

No	Year	Authors	Methods	Number of Samples
1	2011	(Said et al., 2011)	Quantitative	264
2	2013	(Aziz & Chok, 2013)	Quantitative	226
3	2013	(Hussin, Hashim, Yusof, & Alias, 2013)	Quantitative	200
4	2015	(Adura Mohd Yusoff et al., 2015)	Quantitative	304
5	2015	(Pool & Najafabadi, 2015)	Quantitative	864
6	2016	(Azam, 2016)	Quantitative	210
8	2017	(Ali et al., 2017)	Quantitative	2931
7	2017	(Soon & Wallace, 2017)	Quantitative	324
9	2017	(Muhamed et al., 2017)	Quantitative	Not stated in the article
10	2017	(Abu-Hussin et al., 2017)	Quantitative	332
11	2017	(Ya et al., 2017)	Quantitative	201
12	2017	(Afzaal Ali Guo Xiaoling Mehkar Sherwani Adnan Ali, 2017)	Quantitative	436
13	2018	(Elseidi, 2018)	Quantitative	400
14	2018	(Fatema et al., 2018)	Quantitative	200
15	2018	(Garg & Joshi, 2018)	Quantitative	288
16	2018	(Mohd Suki & Abang Salleh, 2018)	Quantitative	480
17	2018	(Putri & Abdinagoro, 2018)	Quantitative	100
18	2018	(Syukur & Nimsai, 2018)	Quantitative	480
19	2018	(Ali et al., 2018)	Quantitative	347
20	2018	(Adnan Ali et al., 2018)	Quantitative	378
21	2019	(Bashir, 2019)	Quantitative	230
22	2019	(Memon et al., 2019)	Quantitative	250
23	2019	(Arbak et al., 2019)	Mixed-Method	110
24	2019	(Khan et al., 2019)	Quantitative	350
25	2019	(Marmaya et al., 2019)	Quantitative	110
26	2019	(Nurzulain et al., 2019)	Quantitative	63
27	2019	(Pasha et al., 2019)	Quantitative	192
28	2019	(Abdalla M. Bashir, Bayat, Olutuase, & Abdul Latiff, 2019)	Quantitative	230
29	2019	(Pradana et al., 2019)	Quantitative	215
30	2019	(Nurhayati & Hendar, 2019)	Quantitative	238
31	2020	(Bukhari et al., 2020)	Quantitative	378
32	2020	(Afzaal Ali et al., 2020)	Quantitative	481
33	2020	(Aslinda Jamil, Atifah Fakhriyah, 2020)	Quantitative	318
34	2020	(Bhatti et al., 2020)	Quantitative	140

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No	Year	Authors	Methods	Number of Samples
Continuance		*Table 2 List of studies affecting halal purchase intention*		
35	2020	(Hassan et al., 2020)	Quantitative	152
36	2020	(M. Pradana et al., 2020)	Quantitative	500
37	2020	(N. Khan et al., 2020)	Quantitative	262
38	2020	(Pradana et al., 2020b)	Quantitative	228
39	2020	(Pradana, Wardhana, et al., 2020)	Quantitative	500
40	2020	(Shaari et al., 2020)	Quantitative	760
41	2020	(Suparno, 2020)	Quantitative	201
42	2020	(Ustaahmetoğlu, 2020)	Quantitative	Not stated in the article
43	2020	(Pradana et al., 2020)	Quantitative	500
44	2020	(Hamzah et al., 2020)	Quantitative	373

RESULT

Overview of the Previous Study

The review of previous studies of purchase intention towards Halal products had led to 44 articles; 23 papers focused on Halal food, seven articles emphasized cosmetics, three articles studied Halal meat, six investigated Halal products, two studied Halal finance, one researched Halal pharmaceutical, one article focused on the Muslim made products. One article is on the retail store (see Table 2).

Table 3 List of papers halal studies by-sectors

No	Scopes	Number of Articles	Authors
1	Food	23	(Afzaal Ali et al., 2017, 2018, 2020; Azam, 2016; Abdalla M. Bashir et al., 2019; Abdalla Mohamed Bashir, 2019; Elseidi, 2018; Hamzah et al., 2020; A. Khan et al., 2019; Marmaya et al., 2019; Nurzulain et al., 2019; M. Pradana et al., 2020; Mahir Pradana et al., 2019; Mahir Pradana, Huertas-García, et al., 2020b, 2020a; Mahir Pradana, Wardhana, et al., 2020; Said et al., 2011; Shaari et al., 2020; Soon & Wallace, 2017; Syukur & Nimsai, 2018; Ustaahmetoğlu, 2020; Ya et al., 2017)
2	Cosmetic and Personal Care	7	(Arbak et al., 2019; Aslinda Jamil, Atifah Fakhriyah, 2020; Garg & Joshi, 2018; Siti Rahayu Hussin, 2013; N. Khan et al., 2020; Putri & Abdinagoro, 2018; Suparno, 2020)
3	Meat	3	(Afzaal Ali, Gua Xiaoling, Mehkar Sherwani, 2017; Adnan Ali et al., 2018; Bhatti et al., 2020)
4	Pharmaceutical	1	(Bukhari et al., 2020)
5	Halal Products	6	(Abu-Hussin et al., 2017; Aziz & Chok, 2013; Memon et al., 2019; Nurhayati & Hendar, 2019; Pool & Najafabadi, 2015; Ya et al., 2017)
6	Finance	2	(Fatema et al., 2018; Muhamed et al., 2017)
7	Muslim Made Products	1	(Hassan et al., 2020)
8	Retail Store	1	(Mohd Suki & Abang Salleh, 2018)

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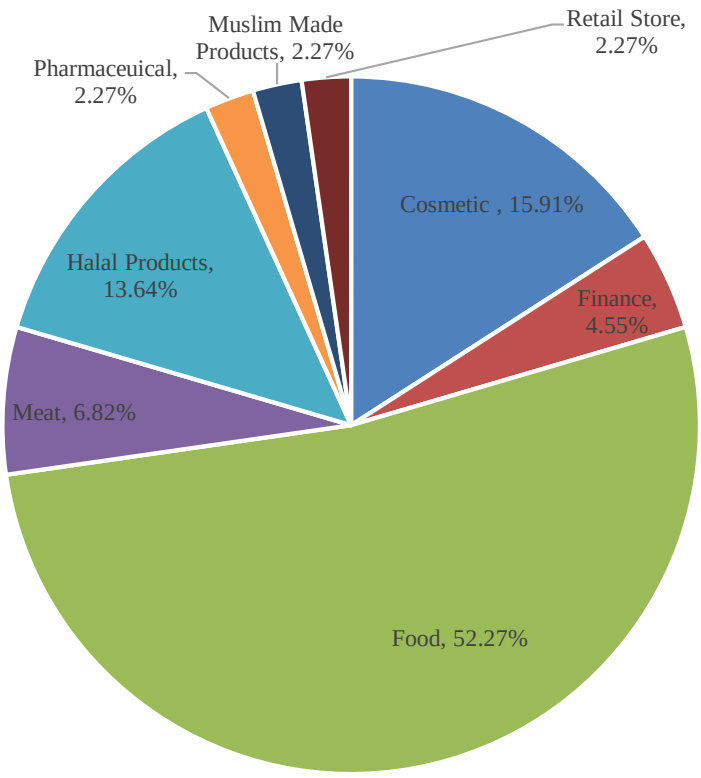

Figure 1: The Percentages of purchase intention halal products articles by sectors

Figure 1 further summarizes and illustrates the percentage of the article based on sectors. The findings indicate Halal foods have been extensively studied compared to other sectors or scopes. Halal foods have topped the chart with 52,27%, followed by cosmetic articles with 15,91%, Halal products with 13,64 %, Halal meat with 6.82%, finance 4,55% and pharmaceutical, retail store, Muslim made products with 2,27 % respectively. The previous researchers used quantitative methods by using questionnaires to test their hypotheses about the relationship between the factors affecting purchase intention towards Halal products. However, only one study conducted by Arbak et al. (2019) used a mixed-method, questionnaires, and interviews with the respondents. The respondents' numbers ranged from 63 respondents (Nurzulain et al., 2019) to 2931 respondents (Soon & Wallace, 2017).

Overall, majorities of studies of purchase intention were conducted by Malaysian researchers with the highest number of 15 articles, followed by China's researchers with five articles. At the same time, Indonesia and Spain produced four papers. Authors from countries such as the United Kingdom, Pakistan, and South Africa have published two related articles. In contrast, authors from Thailand, Turkey, Singapore, Saudi Arabia, Iran, and India published one article related to Halal products' purchasing intention. Researchers from Malaysia collaborated with others from Thailand and Pakistan to study purchase intention in halal products and produced one article for each collaboration. The list of articles published based on the country is shown in Table 3.

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Table 4 The Articles' List of Halal Products, Purchase Intention by Country of Survey

Countries	Number of Articles	%	Authors	Scope of Halal Products							
				Food	Meat	Cosmetic/Personal Care	Pharma ceutical	Halal Product	Halal Finance	Muslim made Products	Retail Store
Bangladesh	1		(Fatema et al., 2018)	-	-	-	-	-	1	-	-
China	5	11.63	(Afzaal Ali, Gua Xiaoling, Mehkar Sherwani, 2017; Afzaal Ali et al., 2017, 2018)	3	2	-	-	-	-	-	-
India	1	2.33	(Garg & Joshi, 2018)	-	-	1	-	-	-	-	-
Indonesia	4	9.30	(Nurhayati & Hendar, 2019; Mahir Pradana et al., 2019; Putri & Abdinagoro, 2018; Suparno, 2020)	1	--	2	-	1	-	-	-
Iran	1	2.33	(Pool & Najafabadi, 2015)					1			
Malaysia	15	32.56	(Adura Mohd Yusoff et al., 2015; Arbak et al., 2019; Aslinda Jamil, Atifah Fakhriyah, 2020; Aziz & Chok, 2013; Hamzah et al., 2020; Hassan et al., 2020; S. R. Hussin et al., 2013; A. Khan et al., 2019; N. Khan et al., 2020; Marmaya et al., 2019; Mohd Suki & Abang Salleh, 2018; Muhamed et al., 2017; Nurzulain et al., 2019; Said et al., 2011; Ya et al., 2017)	6	-	4	-	2	1	1	1
Malaysia dan Pakistan	1	2.33	(Bukhari et al., 2020)	-	-	-	1	-	-	-	-
Norway	1	2.33	(Bhatti et al., 2020)	-	1	-	-		-	-	-
Pakistan	2	4,65	(Memon et al., 2019; Pasha et al., 2019)	1	-	-	-	1	-	-	-
Saudi Arabia	1	2.33	(Azam, 2016)	1	-	-	-	-	-	-	-
Singapore	1	2.33	(Abu-Hussin et al., 2017)	-	-	-	-	1	-	-	-
South Africa	2	4,65	(Abdalla M. Bashir et al., 2019; Abdalla Mohamed Bashir, 2019)	2	-	-	-	-	-	-	-
Spain	4	9.30	(M. Pradana et al., 2020; Mahir Pradana, Huertas-García, et al., 2020a, 2020b; Mahir Pradana, Wardhana, et al., 2020)	4	-	-	-	-	-	-	-
Thailand	1	2.33	(Syukur & Nimsai, 2018)	1	-	-	-	-	-	-	-
Thailand and Malaysia	1	2.33	(Adura Mohd Yusoff et al., 2015)	1	-	-	-	-	-	-	-
Turkey	1	2.33	(Ustaahmetoğlu, 2020)	1	-	-	-	-	-	-	-
United Kingdom	2	4,65	(Elseidi, 2018; Soon & Wallace, 2017)	2							

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Theory Used

This article also reviews the theory used in previous research. Bray (2000) stated that in the past 300 years ago, a few economists led by Nicholas Bernoulli, John von Neumann, and Oskar Morgenstern studied the subject of consumer decision-making, for which they had begun to examine the basis of consumer decision-making. Studies on consumer behaviour have been continued, and several improvements have been established. The theory in consumer decision-making could help us predict the intentions and actions concerning the purchase or use of a particular brand or product and even choose between different brands or products (Arifani & Haryanto, 2018). The previous articles reviewed have employed several theories, such as the Theory of Planned Behaviour (TPB) and Extended TPB, to examine the relationship between the factors influencing halal products' purchasing intention. Other studies, however, did not use any theory as a basis of their determinants.

Theory Planned Behaviour (TPB) is the extension of the Theory of Reason Action (TRA). TRA was established in the 1960s to explain variation in consumer behaviour (Ajzen, 2011). It is useful in multiple studies. TRA consisted of attitudes and subjective norms. In 1985, Ajzen extended the TRA by adding the perceived behavioural control to improve the TRA's predictive power. This extended theory is known as Theory Planned Behaviour (TPB) (Ajzen, 1991). TPB has become one of the most widely cited and influential models for predicting human social behaviour. The core concept of TPB is that people systematically use knowledge before taking action and that their behaviour actions are not taken impulsively.

TPB proposed that behaviour intention is a feature of three aspects: attitude, subjective norms, and perceived behaviour control, and is the most proximal determinant of behaviour impact. The first indicator is the attitude towards behaviour and refers to the degree to which an individual has a favourable or unfavourable assessment or assessment of the behaviour in question. The second indicator is a social factor referred to as a subjective norm; it relates to perceived social pressure to perform or not perform a particular behaviour. The third indicator refers to the perceived behaviour control or difficulty of conducting behaviour, representing experience and expected challenges and obstacles. These motives may account for a substantial proportion of behavioural variance (Ajzen, 2012).

TPB is considered to be one of the most influential theories in the field of social psychology. Even though TPB is an influential theory in social psychology, this theory can also be applied in many contexts because it offers a valuable philosophical structure for coping with human behaviour. It has been used to predict and understand the actions of individuals in various contexts such as purchase intention in the green product (Paul et al., 2016), internet banking (Shih, 2004), organic personal care products (Kim et al., 2011), reuseable shopping bag (Arifani & Haryanto, 2018), halal products (Memon et al., 2019), halal meat consumption (Afzaal Ali, Gua Xiaoling, Mehkar Sherwani, 2017) and Halal food consumption (Syukur & Nimsai, 2018).

Some researchers also tested TPB to assess people's intention to buy by combining TPB factors with variables other than those described above (attitude, social norms, and perceived behavioral control). This hybrid theory is known as extended TPB. Other factors that are relevant to the purchase of halal products and often tested as extended TPB are religiosity (Afzaal Ali, Gua Xiaoling, Mehkar Sherwani, 2017; Bukhari et al., 2020; Garg & Joshi, 2018; A. Khan et al., 2019; Memon et al., 2019), halal certification (Nurzulain et al., 2019), awareness (Abdalla M. Bashir et al., 2019), knowledge (A. Khan et al., 2019; Mohd Suki & Abang Salleh, 2018) and others factors such as trust, self-efficacy, motivation.

Approximately eight papers had analyzed TPB factors, in line with eight articles that examined the theory of extended TPB. About 28 journals article used various determinants without using any particular theory to test the hypothesis between influence factors and halal products' purchase intention. Examples of the determinants used are Halal awareness, religiosity, Halal certification/Halal logo, brand, safety, price, health, ingredients, promotion, quality, advertisement, knowledge, motivation, trust, exposure, and advertising.

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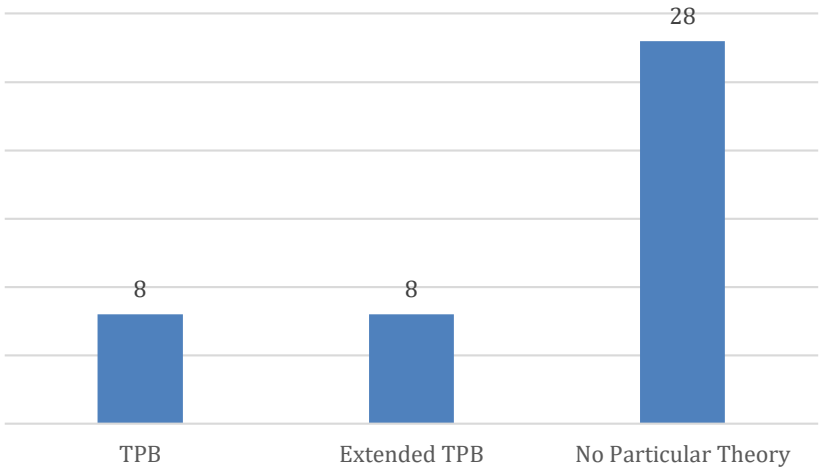

Figure 2- Theories of Purchase Intention Used in Studies of Halal Products

Determinants/Factors Affecting Halal Products Purchase Intention

A systematic analysis of 44 articles related to consumer Halal Purchase Intent identified many factors. A detailed list of all variables affecting Halal purchase intention is given in Table 4. In the first column, the authors identify the various factors influencing the customer halal's purchasing intention, followed by the direction of effect in the next column. The last two columns show: 1) individual studies (as shown in Table 1) that report a specific factor, and 2) the total number of such studies.

Table 5 Determinants affecting halal purchase intention

De**terminants**	**Directions**	**Studies**	**Total Number of Studies**
TPB			
- Attitude	+	6,7,9,10,12,13,14,15,16, 20,21,22,24,26,27,28,35, 36, 38,39,41,	21
	-	25, 31	2
- Subjective Norm	+	8,9, 10, 12,13,15,16,20, 24,25, 26, 29,36,	13
	_	22,27,28,31,35	5
- Perceived Behaviour Control	+	7,9,10, 12,13,15,16,18,20,22, 24,25,26, 29, 35	15
	-	28, 31	2
Halal Awareness / Halal Consciousness	+	2,6,14,21,27,28,29,30,33,35,40	11
Religiosity/Belief/ Credence	+	6,11,12,15,18,24,27,29,30,31,33,37,38, 39.44	14
	-	17	1
Halal Logo / Halal Certification	+	2,6,16,17,21, 26,33,37,44	9
	-	17,36	2

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De**terminants**	**Directions**	**Studies**	**Total Number of Studies**
Continuance	***Table 6 Determinants affecting halal purchase intention***		
Beauty Blogger	-	17	1
Arabic Brand Name	-	17	1
Brand components (brand love, brand personality, brand image, brand characteristic, and brand satisfaction)	+	2,5,6,14, 18,23,32	7
	-	3,8	2
Word of Mouth (WOM)	-	5,44	2
Halal Knowledge	+	24,30	2
Trust	+	8,12,14,20,32	5
Motivational	+	12	1
Self-Efficacy	+	24	1
Self-Identity	+	20	1
Moral Obligation	+	20	1
Influences	+	36	1
Exposure	+	6	1
Price	+	3,34	2
	-	18	1
Ingredients	+	3,37	2
Promotional Influence	+	2,37	2
	-	18	1
Safety	+	13	1
Religious Messages on Adv	+ food	42	1
	- bank loan	42	1
Halal Food Supply Chain	+	4	1
	-	18	1
Place	+	18	1
Country of Origin	+	1	1
Consumer Segmentation	+	34	1
Customer Perception	+	11,19	2
Loyalty	+	32	1
Quality	+	3,32	2
	-	2	1
Shariah Compliance	-	14	1

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De**terminants**	**Directions**	**Studies**	**Total Number of Studies**
Continuance	***Table 7 Determinants affecting halal purchase intention***		
Accessibility	+	40	1
Availability	+	40	1
Marketing Concept	+	44	1
Advertisement contains			
- Honesty	+	23	1
-Sexism	+	23	1
- Racism	+	23	1
-Language	+	23	1
-Intention	+	23	1
Health	+	8, 32	2
Need of cognition	-	39	1
Advertisement	+	5	1

These variables or determinants are divided into two different categories: internal and external factors. The internal factors include variables that are specific to the individual decision. In contrast, the external factors include variables that define the other circumstances in which the respective customer decides.

Internal factors

Internal factors category includes variables related explicitly to a particular decision-maker. These variables are generally the result of personal life experiences (attitudes, values, personality, etc.) and affect the individual's decision-making process. This paper includes the following variables.

Attitude

Table 5 shows that attitude is the most used factor in the studies of consumer purchase intention towards halal products, including food, meat, pharmaceutical, finance, and cosmetics. It is followed by perceived behaviour control. The number of studies using attitude as their halal purchase intention was 21 papers. However, two studies found that attitude does not correlate with the purchase intention of halal products. Generally, it can be concluded that attitude has a positive relation to halal products purchase intention.

Perceived behaviour control

Table 5 shows that perceived behaviour control is an important factor in halal products' purchase intention. The number of studies using perceived behaviour control is 15 articles. Even though two articles stated that perceived behavior control is not supported in Halal products' purchase intention, overall, it still can be said that these factors have positive and direct effects on consumer halal purchase intentions.

Religiosity

Religious people tend to apply religious rules and practices without question (Zakaria et al., 2018). The rise in religiosity relates positively and substantially to the intention of the customers to buy halal products. As shown in Tables 4, fourteen studies reported a positive and direct impact of halal products' purchase intentions; however, only one study mentions that religiosity is unrelated to purchase intention. Therefore, it can be deduced that religiosity plays an essential role for the consumer in their purchase intention of Halal products.

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***Halal awareness/halal* consciousness**

Awareness on Halal or consciousness of Halal was one of the commonly studied variables; eleven papers examined Halal awareness (Table 4). The above findings suggest that Halal awareness has a positive impact on Halal product purchase intention.

Trust

Trust is characterized as a belief or expectation in the performance of such products. Of the 44 studies analyzed by the authors, five papers tested the role of trust in Halal purchase intention. All these studies have shown that trust positively influences the customer's purchase intention.

Halal knowledge

Halal knowledge is one of the variables studied in the purchase intention of Halal products. Two papers explored Halal knowledge's roles in consumers' intention to buy halal products (Table 4). Both showed a positive direction, indicating halal knowledge affects the purchase intention of halal products.

Other internal factors

There other internal factors related to Halal-related purchase intention that is not commonly studied. These factors are loyalty, exposure, self-efficacy, self-identity, moral obligation, motivation, and cognition. All these factors have positive directions to purchase intention towards halal products.

External factors

These factors represent an external force which affects the intention of consumers to purchase Halal products or services. These forces either encourage or discourage consumers from deciding to buy Halal products. These variables are explained below.

Subjective norm/social norm or reference groups

About 18 studies explored the effect of the subjective norm/social norm on Halal products' purchasing intention. The result showed 13 papers found that social norms had a positive relationship with the purchase intention. In contrast, five studies found that the subjective norm had a negative relationship with purchase intention. Pradana et al. (2020) conducted a study in Spain and found that subjective norm has a significant impact on Spain's purchasing intention. The impact on Halal purchase intention may be stronger if Muslims are more interested in religious activities in their communities. Moreover, two studies examined word of mouth, and the result found that word of mouth has a positive impact on the consumer in their intention of buying halal products. To sum up, it can be assumed that arbitrary or social expectations and reference groups have mixed relationships with the consumer's Halal purchase intention.

Halal logo / halal certification

Halal logo/halal certification tells customers about the product's halal characteristics. Halal's description can be labelled on edible products, foods, cosmetics, personal care products, food raw materials, or any food and beverage related product (on their package). The Halal logo could build consumer confidence and promote more sustainable purchases. Nine papers were found to have examined these factors, and the result showed that the halal logo had a substantial effect on Halal purchase intention in seven studies. Unfortunately, two papers reported that the halal logo was not related to halal goods' purchase intention.

Brand components

Some studies assess the role of brand in influencing Halal purchase intention. Brand components considered include brand love, brand image, brand personality, and brand characteristic. As shown in Table 5, seven papers examined studied these determinants with the positive finding; that shown brand components influence Halal products' purchase intention. In contrast, two journal articles found that brand components do not correlate with Halal products' purchase intention. Furthermore, one study

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discussed the relation of Arabic brand name to Halal products' intention, and the results stated that the Arabic name on the brand does not correlate with consumer purchase intention of Halal products.

Product attributes and quality

Factors included in product attributes in halal products' purchase intention include ingredients, safety, healthiness, and quality. Two papers stated that quality significantly influences the purchase intention of halal products. However, the other two papers found that quality attributes have no relation to halal products' purchasing intention. Furthermore, another two papers discussed safety and ingredients, respectively, and the findings showed that both safety and ingredients positively influenced halal products purchase intention.

Price

It has been reported in two studies that price positively affects Halal products' purchase intention. One paper, however, found that price does not influence customers' intention to buy Halal products.

Advertisement

Arbak et al. (2019) uniquely examined the role of advertisement, which includes contents such as honesty, language, sexism, and racism, affecting the purchase intention of halal cosmetics. To attract and retain consumers in Malaysia, marketers must avoid offending consumers by following Islamic advertising ethics. Pool & Najafabadi (2015) found that advertisement positively influenced halal cosmetic purchase intention. While one paper said beauty blogger has no relation to increasing purchase intention (Putri & Abdinagoro, 2018). Two papers studied promotional influence, and the result found that promotional influence has a positive influence on halal products' purchase intention. Ustaahmetoğlu (2020) in Turkey studied religious massage in halal food advertisement positively impacts purchase intention; in contrast, religious massage in bank loan advertisement is significantly not related to purchase intention.

Product availability and accessibility

Shaari et al. (2020) researched 760 consumers in Malaysia and Thailand in a context related to Halal packaged food items. The study found that in a country with a dominant Muslim population, the demand is more accessible. Whereas in non-Muslim dominant countries, consumers seek availability. In general, both accessibility and availability of Halal packaged food items are crucial for stimulating the purchasing intention.

Other external factors

There other external factors studied in previous research as well. Fatema et al. (2018), in their research, stated that in Bangladesh, consumers' intention in purchasing Halal finance products does not influence by Shariah compliance. One article studied another factor such as country of origin, Halal supply chain, place, and marketing concept that positively affects Halal product purchase intention. Bhatti et al. (2020) found consumer segmentation has a positive impact on the purchase intention of halal meat in Norway.

DISCUSSION

Numerous factors affecting customer Halal purchase intention have been identified through a systematic literature review. All of these variables have been found to either promote or discourage the purchasing of halal items. Except for a few studies, multiple studies have found that attitude, subjective norms, perceived behavioral control (also the TPB components), religiosity, Halal awareness, and halal certification/halal logo are the significant factors that influence halal products' purchasing intention.

A previous study mainly found that attitude was a significant factor in shaping Muslim consumers' intention to purchase Halal products. Those with more optimistic attitudes are more likely to have greater intentions to purchase Halal products. In general, these findings indicate that Muslims are aware of, and have a reliable, positive attitude towards Halal products that positively influence their intention

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to purchase these products. The analyses suggested a mainly positive association between perceived behavioural and subjective norms with Muslim consumers' intention to buy Halal products or services. Such findings can be interpreted to indicate that Muslims are more likely to make considerable efforts to obtain halal products. Their subjective norm from their families, friends, and relatives emerged as essential drivers of buying intention. All individuals have different social groups; some social groups may have some "norms" on Halal consumption.

Various literature refers to religiosity as one of the essential influential factors affecting the purchasing of Halal goods. Rasha (2016) strongly argued that Islamic religiosity, health literacy, and faith in Halal food products are the key determinants influencing Muslim consumers' purchase intention on Halal food products. Varinli, Erdem, & Avcılar (2016) have indicated that consumers' preference for Halal-certified products depends on their religiosity level. Religious people tend to apply religious rules and practices unconditionally. As such, the high religiosity relates positively and substantially to the customers' intention to buy Halal products.

Halal awareness is a common factor chosen by the researcher to test their Halal-related purchase intention hypothesis. Previous studies had gathered evidence that Halal awareness affects consumers' intention to buy halal products. The more consumers know about the Halal concept, the more they know the need to purchase Halal products. The halal logo or certificate is also a common factor tested. The Halal logo has become a keyword and plays an increasingly important role in global markets. It is proven that many studies showed that the Halal logo has a direct positive impact on purchase intention towards Halal products.

Unfortunately, there are limited studies to analyze other determinants such as price, place, brand components, advertising, the marketing concept, halal supply chain, etc. Given the limited number of studies conducted, the relationship between some of the factors towards halal products' intention could not be concluded. The researchers must conduct further studies to analyze the significant of these determinants.

CONCLUSION

Implications, limitations and directions for future research

The present research is the first to review articles of determinants affecting purchase intention towards Halal products in a few countries. This research's findings may contribute to understanding the factors that influence halal products and services' purchase intention. Numerous factors encourage or impede the intention to purchase halal products. Factors such as attitude, subjective norms, perceived behavioural control (also the TPB components), religiosity, Halal awareness, and Halal certification/halal logo are significant in Halal purchase intention. Other factors could be significant in improving the purchase intention. However, to determine the position of these factors and the degree to which they influence Halal products purchase intention, further research is required.

This study's results may provide insights into the creation of literature and be valuable to scholars by giving insight into existing factors affecting Halal purchase intention. Another possible research area is applying other purchase intention theories, such as theory consumption value or theory diffusion of innovation in the future. As the demand for Halal lifestyle globally has been increasing every year, more studies can be done in other relatively under-explored fields in the future, such as halal pharmaceutical, Halal fashion, Halal tourism, Halal supply chain, Halal finance. It is recommended for future review studies to adopt more databases to be explored.

Market researchers in general and foreign brands could use this knowledge to plan for their marketing strategies. Producers and retailers will do well to integrate this study's marketing strategies to attract more customers and persuade them to purchase their goods. The government can use this knowledge to improve consumers' purchase rates on Halal products, which may facilitate their local Halal market growth.

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Journal of Halal Product and Research

SHOULD VACCINE BE HALAL? BIBLIOGRAPHY STUDY IN SCOPUS INDEXED ACADEMIC PAPER

HARUSKAH VAKSIN HALAL? KAJIAN BIBLIOGRAFI DALAM MAKALAH AKADEMIK TERINDEKS SCOPUS

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ABSTRACT

Vaccine is the best way to tackle the virus outbreak, because vaccines could reprogram immunity systems to create their own antibodies. Muslims are obliged to consume only halal product. Vaccine needed to follow halal standardization to be used in Islamic countries. This study has a purpose to observe the connection between halal and vaccine in research. This study uses papers indexed in Scopus website as secondary data. There are two kinds of data, based on *the organization of co-authorship*, and *co-occurrence of authors'* topic. There are 46 numbers of data, include *the organization of co-authorship* or where the authors affiliated and 68 of *co-occurrence of authors' topic*. The data is analyzed using Vosviewer software. The result shows that topic of vaccine has connection to halal and fatwa/ or ulama council's statement. Thus, non muslim countries such as USA and Australia have more relevance point than Muslim countries. In can be concluded that halal and vaccine is intertwined each other, especially in Muslim countries.

Keywords: Connection, Halal, Muslim, Scopus, Vaccine.

ABSTRAK

Vaksin adalah cara terbaik untuk mengatasi wabah virus, dikarenkan vaksin dapat menambah proteksi sistem kekebalan untuk membuat antibodi sendiri. Setiap muslim diwajibkan hanya mengkonsumsi produk halal, termasuk vaksin. Vaksin dibutuhkan untuk mengikuti standarisasi halal untuk digunakan di negara dengan penduduk mayoritas muslim. Penelitian ini bertujuan untuk melihat keterkaitan antara halal dan vaksin dalam penelitian. Penelitian ini menggunakan data data paper yang terindeks di website Scopus sebagai data sekunder. Ada dua jenis data, berdasarkan afiliasi penulis berjumlah 46 bersama, dan 68 topik penulis. Data dianalisis menggunakan software Vosviewer. Hasil penelitian menunjukkan bahwa topik vaksin berkaitan dengan halal dan fatwa/pernyataan majelis ulama. Dengan demikian, negara non muslim seperti USA dan Australia memiliki titik relevansi yang lebih dibanding negara muslim. Dengan demikian dapat disimpulkan bahwa halal dan vaksin saling terkait, terutama di negara-negara Muslim.

Kata Kunci: *Koneksi, Halal, Muslim, Scopus, Vaksin.*

INTRODUCTION

In 2019, global communities are shocked by the new outbreak which has been causing massive death until recently. Severe acute respiratory syndrome coronavirus 2 or SARS-CoV-2 is a new type of virus which attacks the respiratory system created by coronavirus disease known as COVID-19. SARS-CoV-2 is dangerous to people with weak immunity or chronic disease such as high blood pressure, diabetes, heart problem, and other organ problems. This type of virus is really contagious that the dissemination is really fast, infecting almost all countries in the world. SARS-CoV-2 has a shape like crown which has spikes to stick itself into the human cell and organ to start the infection (Shang et al., 2020).

Governments of each country implement the regulation and treatment to stop the dissemination of the virus, such as implementing a new medical protocol in society. The United States of America, Russia, United Kingdom, and Japan do the research medicine which works as antiviral is needed for treating the infected such as Remdesivir, Dexamethasone, Avigan to speed up the recovery process. However, medicine cannot be used in a long time because of the side effects which are harmful to the human body. The alternative way is by doing observation in the pharmaceutical substance inside herbs and plants that could work as antiviral, anti-inflammation, or immunity booster (Rome and Avorn, 2020).

Many countries believe that vaccine is the key point in stopping the spread of SARS-CoV-2. Vaccine consists of a weakened virus to make the white blood cell predate it and create its own molecule known as antigen. But not all of the vaccines consist of weakened virus; there are also inactive vaccines which consist of particles or a dead virus for people with weak immune system. Antigen is a substance that can stimulate the immunity system to produce antibodies to create a defense system in preventing the same virus invading the body (Sienel et al., 2004). Antibodies are produced by cells in the body's immune system called lymphocytes. But the problem of vaccines is it needs a long time to conduct preclinical and clinical stages. Those stages must be done in order to ensure safety before being sued for clinical trials into humans (Shoenfeld, 2020).

Muslims are restricted to follow the regulation instructed by The Holy Qur'an and Hadith. One of the regulations for Muslims is to use halal products which is being consumed or used in the body. This include vaccine as a medical product who need to be injected into human body to create own antibody against targeted virus. To cope with the problem, academicians around the world conduct research about the relation of halal such as standardization, regulation, ethical research method toward vaccine production and its process (Padmawati et al., 2019). Scopus as one of the biggest international companies in measuring the standard of international paper has become the direction for academicians to publish their paper (Klapka and Slaby, 2018). Based on the background above, this study has an aim to observe the connection between halal and vaccine in research papers indexed by Scopus website.

METHODOLOGY

This study is classified as quantitative using data mining technique in gathering the data. This study only uses secondary data as the sample of the research. This study uses samples of meta-data from papers which are included in Scopus website. The data is saved in a CSV file and processed by Vosviewer software. Vosviewer is the software in mapping the data to create visualization and connection of each data. Vosviewer can analyze data from Scopus, web of science, Pubmed, and Thompson for bibliography data. Vosviewer can also analyze topic, abstract, and keyword from certain open analysis website, such as Google trends, Bloomberg, Osiris, Scival, etc. The data connection is visualized in a branch like neuron and represented as color (Polley, 2016).

There are two kinds of data, based on *the organization of co-authorship*, and *co-occurrence of authors' topic*. There are 46 numbers of data *the organization of co-authorship* and 68 of *co-occurrence of authors' topic.* The inclusion criteria of the sample are paper written by global academicians, included as social science subject, written in English, published by a journal indexed by Scopus, having a keyword *halal*, *vaccine,* and Islam. The data is gathered from 2016-to 2020 period. The location of sample is Indonesian universities written paper related to halal and vaccine (Jan et al., 2019).

The result of *the co-occurrence of authors' topic is then* depicted into two types, the connection between each keyword portrayed in figures to show the strings connected in each keywords, and in table to show the relevance point of each keyword. The relevance point shows how strong a topic is related to the keywords *halal* and *vaccine*. The relevance point is measured from 0-15 based on the study by Batcha et al. the relevance point is limited to minimum 5 to max 15, according to a study written by Gaitán-Angulo et al. Data about *The organization of co-authorship* is depicted in the table only (Gaitán-Angulo et al., 2018).

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FINDING AND DISCUSSION

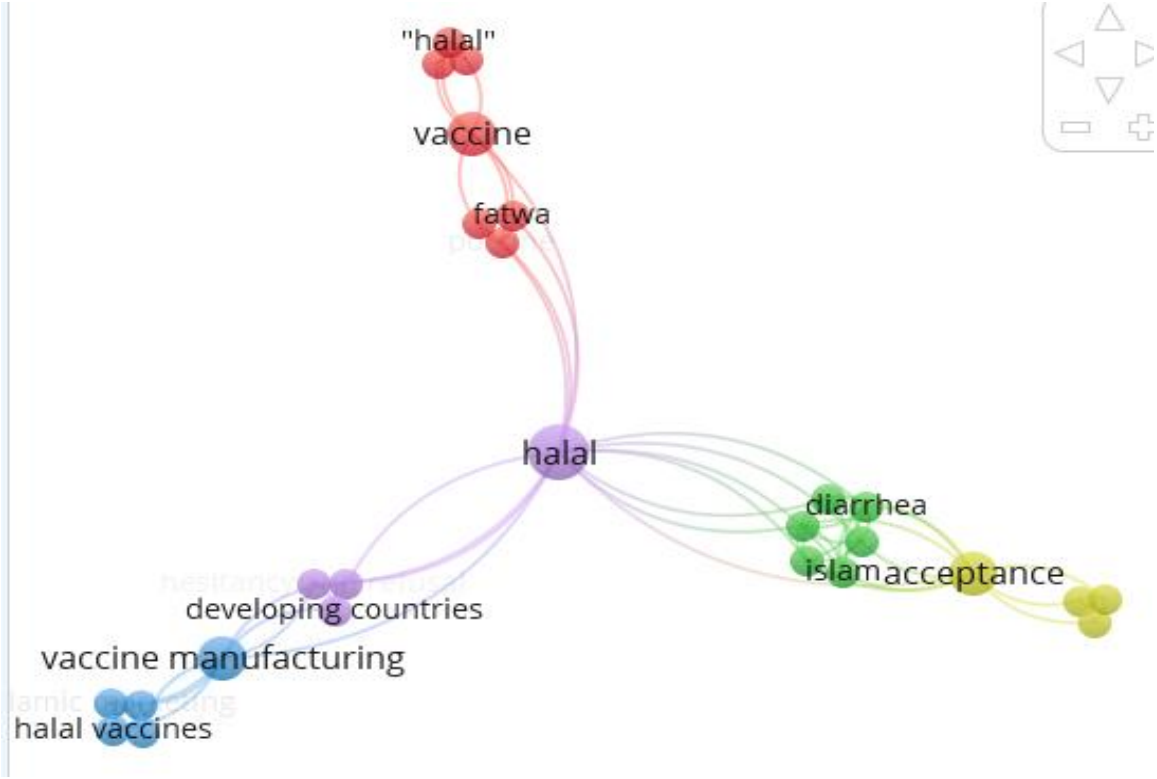

Figure 1 the connection between each topic related to Halal and Vaccine in Scopus Indexed Academic Paper

Figure above shows that the topic about halal itself is divided into three branches based on other related topics. There are branches of string about fatwa and vaccine manufacturing in dividing the topic of the research. But only two branches which have topics about halal and vaccines. Those are purple connected to blue strings and red strings, while green strings connected to yellow have not. Vosviewer distinguishes each main data represented in color, so that it won't get jumbled with each other and makes researchers easier to read the data (Yu et al., 2020). Those who have stronger connection are depicted in red color branch to lesser one as Scopus is the database of papers from thousands of reputable journals around the world. one major of study could include many collaborations with other majors, for example pharmaceuticals with computational science, sociology, cultural studies, law, economy, etc. By doing collaborative research with other majors as a sub topic, a paper will be enriched in the novelty and could increase the reputation of the journal itself (Ence et al., 2016).

Halal certification has an essential role for companies and manufactures to determine their brand awareness into society. Society in Muslim countries always keeps in check any product that they consume whether follow the ethic of halal standardization or not. As a result, all entities or business actors must pay attention of their product starting from raw materials to finished products before reaching consumers. Especially in Asia, the regulation of Asian Free Trade Area (AFTA) now has an impact on increasing circulation and distribution of food, beverage, and service product (Sun et al., 2020). The implementation of halal products has a purpose to provide comfort, security, safety and certainty for Muslims to consume and targeted products. Moreover, label of halal could adds more value in product brands (Anggara, 2017).

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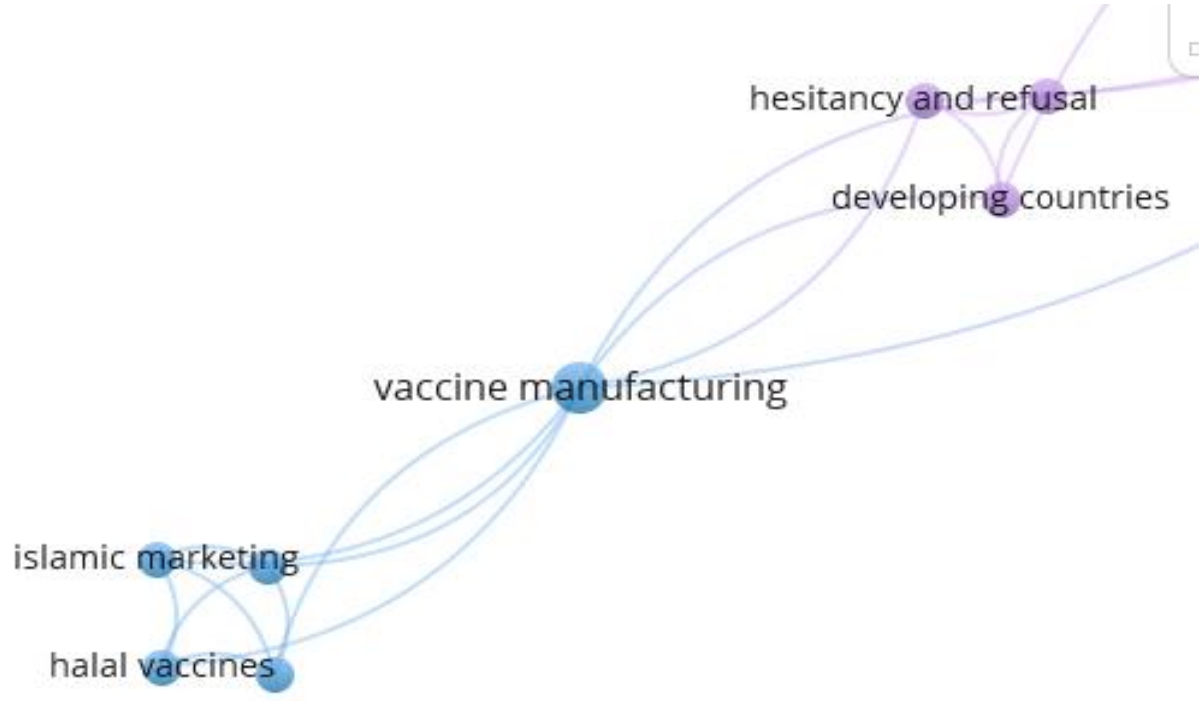

Figure 2 Branches of Topic Related to Halal

The figure above shows that there is a topic about Islamic marketing in halal vaccines. To educate society about the importance of halal standardization in vaccines, product marketing has to be emphasized to create brand awareness. There is also topic *vaccine manufacturing* connected to topics of *islamic marketing* and *halal vaccine.* Bin Abdullah states in his study that manufacturing proposed products have to be considered after researching the target market to know how well the proposed product will be well received in society. as the target market is good, the product will be manufactured and started to get promoted into society through the marketing team (Bin Abdullah, 2014).

Figure above also shows that there are two topics connected to *vaccine manufacturing* such as *hesitancy and refusal* and *developing countries*. Ayuniyyah et al on their study state that production process of vaccine have to undergo several inspection regarding of the regulation of Islamic or Ulama council developing countries, especially with high number of Muslim such as Indonesia (Ayuniyyah et al., 2017). Every country has its own standardization of halal, according to their own Ulama council and government. the vaccine that is still have not received an approval is highly doubted by society and often causes refusal into target market Ulama Council in every country become the prominent marketer in gaining acceptance of new vaccine to be accepted in clinical trial (Sukardani et al., 2018).

Figure 3 Branch of topic related to *vaccine*

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Figure above shows that the topic *vaccine* is related to some Islamic regulation such as *fatwa* and *istihalah*. *Fatwa* means that the statement from Ulama council to determine whether a product or a lifestyle is prohibited or allowed in Islam. *Istihalah* means that the statement that determines the changing of regulation of proposed product or lifestyle from prohibited/haram into allowed/halal (Maison et al., 2019). The example, alcohol is banned to be consumed by Muslims but vinegar which contains alcohol is allowed to be consumed as seasoning. Figure above shows that there is a topic of *porcine,* or products using the substance from pig (Wilkins et al., 2019). It means that there are some studies which observe the statement of Ulama council whether the proposed vaccine uses porcine or not in the production process to become a reference to release a new *fatwa* based on the fact.

There is also topic *diphtheria* depicted on figure above means that a paper with the topic of halal also discuss about diphtheria vaccine. Diphtheria vaccine is commonly given to children and piqued many debates with the muslim globally, because the vaccine itself has been questioned as halal or haram. Any topic which is appeared in a figure above is the topic included in some of the paper written by Indonesian academician.

Organization	Documents	Total Link Strength
Harvard School of Public Health, Boston, United States	1	6
Intermedia, Washington DC, United States	1	6
John F Kennedy School of Government, Cambridge, United States	1	6
Ministry of Public Health, Kabul, Afghanistan	1	6
Reston VA, United states	1	6
SSRS, Mediapa, United States	1	6
UNICEF, New York, United states	1	6
Ajman University, College of Pharmacy, Ajman, United Arab Emirates	1	5
Department of Pharmacy, State University of Bangladesh, Dhaka, Bangladesh	1	5
School of Pharmacy, School of Medicine, University of Tasmania, hobart, Australia	1	5
School of Pharmacy, KPJ Healthcare University College, Nilai, Negeri Sembilan, Malaysia	1	5
School of Pharmacy, Monash University, Bandar Sunway, Selangor, Malaysia	1	5
Vector-Borne Diseases Research Group (VERDI), Pharmaceutical and Life Sciences Core, Universiti Teknologi Mara, Shah Alam, Selangor, Malaysia	1	5

Table 1 List of Universities that Publish Paper about Halal and Vaccine Indexed by Scopus

Table above shows that non Muslim countries such as United States and Australia are also interested in researching about *halal* and *vaccine* as subject. Moreover, it can be seen in the table above that papers published by universities in the United States have stronger relevance point than Islamic countries, except Afghanistan. Harvard as the first ranked university in the world by Webometric and QS World University also take a lead in the research about this topic too (Farashi et al., 2020).

From Southeast Asia, there are three Malaysia universities with similar relevance points, 5. Malaysia has been actively promoting the sharia economy system in its own country along with the conventional banking system called *dual banking system* (Sukmana and Kassim, 2010). Malaysia realizes that the development of the halal industry will become more competitive with the involvement of the financial industry and Islamic banking sectors.as a result, Halal becomes a general indicator to ensure product quality and living standards (Henderson, 2016).

Thus, in 2016 Malaysia also planned to develop database of halal research. Deputy Minister, Senator Datuk Asyraf Wajdi Dusuki suggested that Mara Technology University (UITM) to cooperate with regulator to develop the halal research database and cooperate with Malaysian regulators (Sulaiman

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et al., 2018). The database of halal could increase halal literacy in society, because it is widely known that society only realize the halal standard of certain products by label. Moreover, the rise of e-commerce and online shop needs more supervision in observing whether the products are following ethical standard of halal or not. Thus, database of halal is important to compile the list of products, manufacturing process, and service whether are following halal standard or not to give insight for public and local government (Atan and Azram, 2019).

UNICEF also provides the academic paper about halal and vaccine which is agood information for children organizations around the world to implement the correct procedure in giving vaccine to the children. Burton et al in their study state that UNICEF contribution now is broadened towards the maintenance to promote prosperous conditions for mothers and children, especially in developing countries and troubled area (Burton et al., 2009). UNICEF's fundamental mission remains the same, namely to strive to provide humanitarian assistance in the fields of health and nutrition, water and environmental hygiene for the children welfare, despite various changes in situations and conditions at the international level (Snider and Hijazi, 2020).

Keywords	Occurrences	Total Link Strength
vaccine manufacturing	2	8
diarrhea	1	7
immunization	1	7
Islam	1	7
religious	1	7
rotavirus	1	7
rotavirus vaccine	1	7
vaccine	2	7
association	1	6
attitude	1	6
attitudes to vaccines	1	6
knowledge	1	6
Malaysian	1	6
Muslim	1	6
perception	1	6
vaccine acceptance	1	6
vaccine confidence	1	6
vaccine hesitancy	1	6
coronavirus disease-2019	1	5
epidemic	1	5
halal food	1	5
Iran	1	5
pneumonia	1	5
SARS-COV-2	1	5

Table 2 List of keywords related to topic of halal and vaccine

Table above shows that topics *halal* and *vaccine manufacturing* have stronger relevance points than other topics. It can be concluded that the topic of *vaccine manufacturing is* dominant to be discussed in Scopus academic papers. There are also topics related to COVID-19 which could give useful insight to medical experts to overcome the latest pandemic in 2020. There are several topics related to vaccine toward society such as *vaccine acceptance, hesitancy, confidence*, and *attitude to vaccine* which could inform the pharmaceutical companies and government to create better strategies in manufacturing vaccine (Cohen, 2020).

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There is also a topic *pneumonia* which has similar symptom to COVID-19. But there is a difference between pneumonia and COVID-19. Pneumonia causes inflammation of the air sacs in one or both lungs and filled with fluid. However, pneumonia could be disappeared by itself if the patients have strong immunity system (Lodding et al., 2018). However, COVID-19 generally attacks the upper airway of respiration tract which could disseminate to the lungs. This virus could create blockages in these respiratory organs and can cause fatal damage to the lungs if there is no immediate medical treatment (Zhang et al., 2020).

There are only two countries which are included in keywords based on the table above. Those countries are Malaysia and Iran. It can be inferred from table above that more papers observe the issue of halal standardization toward vaccine manufacturing in Malaysia and Iran. Both of those countries ensure that public hospital vaccines have halal certification. Muslims countries have additional standard regarding the acceptance of vaccine product before being implemented in clinical trial (Wong et al., 2020).

CONCLUSION

Based on topic of vaccine has connection to halal and fatwa/ or ulama council's statement. Halal is not only related to vaccine based on the result above, but also has connection to other topic such as fatwa, Islamic marketing, developing countries, Islamic and acceptance. Halal and vaccine has vast varieties of sub topic to be developed in studies. Based on the keywords in the papers, non Muslim countries such as USA and Australia have more relevance point in the study about halal and vaccine. There are vaccine perceptions from society, things related to halal, as well as things related to COVID-19. It can be concluded that halal and vaccine has close relationship with each other in publishing paper indexed by Scopus.

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Saccharomyces cerevisiae DALAM PEMBUATAN PRODUK HALAL BERBASIS BIOTEKNOLOGI KONVENSIONAL DAN REKAYASA GENETIKA

Saccharomyces cerevisiae IN MAKING HALAL PRODUCTS BASED ON CONVENTIONAL BIOTECHNOLOGY AND GENETIC ENGINEERING

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ABSTRAK

Indonesia merupakan negara dengan penduduk mayoritas muslim terbesar di dunia. Kebutuhan terhadap produk halal sangat penting bagi kehidupan seorang muslim. Termasuk diantaranya adalah pemenuhan bahan pangan halal dan juga bahan olahan. *Saccharomyces cerevisiae* telah banyak berkontribusi dalam proses bioteknologi baik konvensional maupun modern misalnya rekayasa genetika. Bioteknologi konvensional telah ada sejak zaman dahulu dengan memanfaatkan mikroba untuk pembuatan makanan dan minuman berkarbohidrat rendah dan dapat disimpan lama. Produk-produk yang dihasilkan pun beragam, ada yang halal dan juga ada yang haram. Produk halal seperti roti, tape dan bioetanol yang dimanfaatkan sebagai bahan bakar. Sementara produk haram diantaranya minuman-minuman yang memabukkan seperti sake. Seiring berkembangnya teknologi bioteknologi modern yang sedang berkembang saat ini seperti rekayasa genetika pada pembuatan bioetanol yang dapat dimanfaatkan sebagai bahan bakar alternatif yang ramah lingkungan.

Kata kunci: *Saccharomyces cerevisiae*, bioteknologi konvensional, rekayasa genetika, produk halal

ABSTRACT

Indonesia is the nation with the world's largest Muslim population. Halal products is very important for the life of a Muslim. This includes the fulfillment of halal food, especially food-processed materials. Saccharomyces cerevisiae has contributed a lot in biotechnological processes in both conventional and modern biotechnology genetic engineering. Conventional biotechnology has been around since time immemorial by utilizing microbes for the manufacture of low-carbohydrate, long-lasting foods and drinks. The products produced also vary, some are halal or haram. Halal products such as bread, tape and bioethanol are used as fuel. Illegal products include intoxicating drinks such as sake. The development of modern biotechnology technologies that are currently developing such as genetic engineering in the manufacture of bioethanol which can be used as an alternative fuel that is environmentally friendly.

Keywords: *Saccharomyces cerevisiae, conventional biotechnology, genetic engineering, halal products*

PENDAHULUAN

Indonesia merupakan negara dengan mayoritas penduduk Islam terbesar di dunia. Kondisi ini menjadikan Indonesia sebagai tempat potensial bagi pengembangan berbagai produk halal. Seiring dengan peningkatan konsumsi produk halal dunia dari tahun ke tahun sebagaimana dilaporkan oleh *Global Islamic Economic* setiap tahunnya, tingkat konsumsi tersebut diperkirakan akan terus meningkat pada tahun 2021. Peningkatan ini ditaksir sebesar US$ 3 triliun dengan konsumsi makanan dan minuman sebesar US$ 1.9 triliun (Ishaq dan Prayoga, 2017). Pangan halal merupakan komponen utama dalam pasar halal. Syariat Islam memerintahkan setiap pemeluknya untuk mengkonsumsi pangan yang halal dan baik sebagaimana firman Allah "*Dan makanlah makanan yang halal lagi baik dari apa yang Allah rizkikan kepadamu dan bertakwalah kepada Allah yang kamu beriman kepada-Nya*" (QS. Al Maidah: 88) (Kurniadi dan Frediansyah, 2016). Oleh sebab itu kehalalan suatu produk pangan merupakan faktor kritis yang harus diperhatikan oleh semua *stakeholder* dalam proses konsumsi, produksi maupun pemasaran produk halal. Terlebih, agama atau kepercayaan menjadi faktor paling penting dalam pemilihan makanan oleh konsumen muslim selain ketersediaan, budaya, nutrisi dan keterbatasan dietetik (Suradi *et al.,* 2015 dalam Atma *et al.,* 2017).

Salah satu isu menarik terkait pangan halal adalah penggunaan mikroba yang saat ini telah menjadi tren di dunia industri. Mikroba menjadi agen bioproses penghasil metabolit dan senyawa baru, agen pemecah molekul kompleks, penghasil aroma, rasa maupun warna. Mikroba juga berperan penting dalam menjaga keseimbangan mikrobiota usus manusia. Modifikasi gen atau *Genetically Modified Technology* (GMT) merupakan bagian dari era bioteknologi telah banyak diterapkan pada berbagai tipe mikroba (Kurniadi dan Frediansyah, 2016). Seiring perkembangan zaman, kebutuhan terhadap makanan terus meningkat sehingga perlu adanya upaya peningkatan dan perbaikan kuantitas serta kualitas pangan. Penelitian di bidang bioteknologi ini diharapkan mampu meningkatkan nilai guna dan manfaat dari berbagai jenis bahan pangan untuk memenuhi kebutuhan manusia (Bartholomaeus *et al.,* 2013 dalam Faridah dan Sari, 2019), termasuk penyediaan bahan pangan halal.

Bioteknologi dideskripsikan sebagai suatu teknologi yang menggunakan dan memanfaatkan sistem hayati untuk mendapatkan barang dan jasa yang berguna bagi kesejahteraan manusia. Terdapat dua macam bioteknologi yaitu bioteknologi konvensional atau tradisional dan bioteknologi modern. Bioteknologi tradisional tanpa rekayasa genetika fokus pada cara seleksi alam mikroba yang digunakan dalam modifikasi lingkungan untuk memperoleh produk optimal misalnya pembuatan tape, tempe, roti, bir, dan lain-lain. Sementara bioteknologi modern dengan rekayasa genetika memanfaatkan keterampilan manusia dalam melakukan manipulasi makhluk hidup agar dapat digunakan untuk menghasilkan barang yang diinginkan dalam bidang produksi pangan misalkan tanaman transgenik. Baik bioteknologi konvensional maupun modern bisa digunakan untuk konservasi pangan. Penggunaan bioteknologi konvensional digunakan untuk meningkatkan nilai gizi dan cita rasa suatu bahan pangan sedangkan bioteknologi modern berperan sebagai salah satu cara untuk memproduksi suatu bahan pangan dalam jumlah besar dan memperbaiki nilai gizi menggunakan rekayasa genetika (Wusqo, 2014).

Secara ilmiah, rekayasa genetika adalah manipulasi genetik atau perubahan dalam susunan genetik dari suatu organisme. Tujuan dari rekayasa genetika adalah mendapatkan organisme yang unggul. Rekayasa genetika merupakan proses sintesis dengan menggunakan teknologi DNA rekombinan. Hasil dari rekayasa genetika adalah sebuah organisme yang memiliki sifat yang diinginkan atau organisme dengan sifat unggul. Organisme hasil rekayasa genetika disebut organisme transgenik (Purnawidjaya, 2015).

Saccharomyces cerevisiae telah banyak berkontribusi dalam proses bioteknologi konvensional maupun bioteknologi modern rekayasa genetika. *Saccharomyces cerevisiae* merupakan organisme penghasil amilase yang cukup berpotensi, selain bakteri dan kapang. Khamir amilolitik mempunyai potensi penting dalam produk-produk berbahan pati karena aktivitas enzim amilase terutama iso amilase dapat menghidrolisis ikatan α pada amilopektin. Selain itu, khamir amilolitik berperan dalam memproduksi etanol. Biomassa khamir berasal dari bahan yang mengandung zat pati dan fermentasi beras untuk memproduksi minuman dan makanan berkarbohidrat rendah serta produksi amilase oleh khamir selama fermentasi tape ketan (Kustyawati *et al.,* 2013). Ragi tape digunakan untuk pembuatan produk fermentasi seperti misal tape ketan dan tape singkong. Ragi tape berasal dari tepung beras yang

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dicampurkan dengan bahan-bahan lain sehingga dapat membantu dalam proses fermentasi. Di dalam ragi ini, terdapat mikroorganisme yang dapat mengubah karbohidrat (pati) menjadi gula sederhana (glukosa). Karbohidrat (pati) yang difermentasi maka menghasilkan asam laktat yang akan menurunkan nilai pH sehingga menimbulkan rasa asam (Oktaviana *et al.,* 2015).

Temperatur pertumbuhan yang optimum untuk *Saccharomyces cerevisiae* adalah 25 - 30°C dan pH optimum untuk pertumbuhan adalah 4,5 - 5,5. Beberapa kelebihan *Saccharomyces cerevisiae* dalam proses fermentasi yaitu mikroorganisme ini cepat memperbanyak diri, tahan terhadap kadar alkohol yang tinggi, mempunyai sifat stabil dan cepat mengadakan adaptasi. Pertumbuhan *Saccharomyces cerevisiae* dipengaruhi oleh adanya penambahan nutrisi yaitu unsur C sebagai sumber karbon, unsur N yang diperoleh dari penambahan urea, ZA, amonium dan pepton, mineral dan vitamin (Umaiyah *et al.,* 2014).

Berdasarkan latar belakang di atas, penelitian ini bertujuan untuk mengkaji penggunaan mikroba *Saccharomyces cerevisiae* dalam pembuatan produk makanan halal berbasis bioteknologi konvensional dan rekayasa genetika.

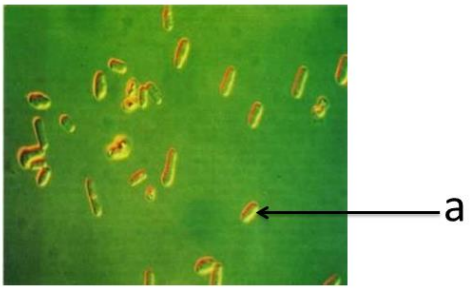
METODE PENELITIAN

Penelitian ini menggunakan analisis deskriptif dengan menggunakan kajian pustaka terhadap literatur buku dan jurnal dengan tema penggunaan mikroba *Saccharomyces cerevisiae* dalam pembuatan produk makanan halal, baik berbasis bioteknologi konvensional maupun rekayasa genetika. Penelusuran data dilakukan mulai tanggal 15 Juni 2020.

HASIL DAN PEMBAHASAN

Saccharomyces cerevisiae

Saccharomyces adalah genus dalam kerajaan jamur yang mencakup jenis ragi (Mayangsari dan Agus Krisno, 2012). Salah satu contoh dari genus ini adalah spesies *Saccharomyces cerevisiae* yang digunakan dalam pembuatan anggur, roti, dan bir (Bahri, *et al* 2018). Ragi atau khamir adalah jamur yang terdiri dari satu sel dan tidak membentuk hifa. Termasuk golongan jamur *Ascomycotina*. Reproduksi dengan membentuk tunas (*budding*) (Bahri, *et al.,* 2018). Genus ini ada yang hanya terdiri dari sel tunggal (uniseluler) maupun bersel banyak (multiseluler). Setiap sel memiliki kemampuan untuk mengalami pertumbuhan, memperbanyak diri, dan menghasilkan energi (Faridah dan Sari, 2019). Spora *Saccharomyces cerevisiae* berbentuk bulat atau pipih (Agustining, 2012). Khamir *Saccharomyces cerevisiae* merupakan mikroorganisme yang bersel tunggal dengan panjang 1-5 µm sampai 20-50 µm, dan lebar 1-10 µm. Bentuk sel khamir bermacam-macam, yaitu bulat, oval, silinder, ogival (bulat panjang dengan salah satu ujung runcing), segitiga melengkung (*triangular*), berbentuk botol, bentuk alpukat atau lemon, membentuk pseudomiselium, dan sebagainya. Ukuran dan bentuk sel khamir mungkin berbeda pada kultur yang sama, karena pengaruh umur sel dan kondisi lingkungan (Widyanti dan Moehadi, 2016) Morfologi *Saccharomyces* seperti pada Gambar 1.



Gambar 1 Morfologi *Saccharomyces cerevisiae*
(**a**. sel tunggal *Saccharomyces cerevisiae*)
(Widyanti dan Moehadi, 2016)

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Menurut Agustining (2012) klasifikasi *Saccharomyces cerevisiae* adalah sebagai berikut.

Kingdom	: Fungi
Filum	: Ascomycota
Subfilum	: Saccharomycotina
Kelas	: Saccharomycetes
Ordo	: Saccharomycetales
Famili	: Saccharomycetaceae
Genus	: *Saccharomyces*
Spesies	: *Saccharomyces cerevisiae*

Saccharomyces cerevisiae dianggap sebagai mikroorganisme aman dan paling komersial saat ini. Penduduk Indonesia mengenal *Saccharomyces cerevisiae* dengan jamur ragi. Jamur ini digunakan dalam industri fermentasi karena kemampuannya dalam menghasilkan alkohol (Mayangsari dan Agus Krisno, 2012). *Saccharomyces cerevisiae* juga digunakan dalam pembuatan roti dan bir (Bahri *et al.,* 2018), serta digunakan di bidang rekayasa genetika (Mayangsari dan Agus Krisno, 2012).

Pembuatan produk halal berbasis bioteknologi konvensional

Bioteknologi konvensional atau tradisional adalah bioteknologi yang memanfaatkan mikroorganisme untuk memodifikasi bahan dari alam untuk memperoleh produk optimal. Misalnya pembuatan tempe, tape, roti, dan pengomposan sampah. Bioteknologi memanfaatkan bakteri, ragi, kapang, alga, sel tumbuhan atau sel hewan yang dibiakkan sebagai konstituen berbagai proses industri (Sutarno, 2016). Bioteknologi pangan didefinisikan sebagai aplikasi teknik biologis untuk hasil tanaman pangan, hewan, dan mikroorganisme dengan tujuan meningkatkan sifat, kualitas, keamanan, dan kemudahan dalam proses dan produksi makanan. Hal ini termasuk proses produksi makanan tradisional seperti roti, asinan atau acar, dan keju yang memanfaatkan teknologi fermentasi (Pramashinta *et al.,* 2014).

Menurut Fardiaz (1992) dalam Algus (2014), sel *Saccharomyces cerevisiae* dapat tumbuh pada medium yang mengandung air gula dengan konsentrasi tinggi. *Saccharomyces cerevisiae* merupakan golongan khamir yang mampu memanfaatkan senyawa gula yang dihasilkan oleh mikroorganisme selulotik untuk pertumbuhannya. Spesies ini dapat memfermentasikan berbagai karbohidrat dan menghasilkan enzim invertase yang bisa memecah sukrosa menjadi glukosa dan fruktosa serta dapat mengubah glukosa menjadi alkohol dan karbondioksida sehingga banyak digunakan dalam industri pembuatan tape dan roti (Algus, 2014).

Produk Tape

Tape merupakan makanan tradisional berbahan baku singkong maupun ketan yang diolah melalui proses fermentasi. Tape memiliki tekstur yang lunak berair, beraroma alkohol dan mempunyai rasa yang manis. Kandungan gizi tape ketan diantaranya protein, lemak, karbohidrat, kalsium, fosfor, besi dan vitamin B1. Selama fermentasi, tape mengalami perubahan biokimia akibat aktivitas mikroorganisme. Mikroorganisme yang berperan dalam proses pembuatan tape berasal dari genus *Aspergillus, Saccharomyces* dan *Acetobacter*. Mikroba *Aspergillus* dalam pembuatan tape berfungsi untuk menghidrolisis pati pada bahan baku menjadi gula-gula sederhana, *Saccharomyces* berfungsi mengubah gula menjadi alkohol, sedangkan *Acetobacter* mengubah alkohol menjadi asam laktat. Hal ini sesuai dengan Ganjar (2003) bahwa dalam proses fermentasi tape digunakan beberapa jenis mikroorganisme seperti *Saccharomyces cerevisiae*, *Rhizopus oryzae, Aspergillus* dan *Acetobacter* (Kanino, 2019).

Proses pembuatan tape ketan dan singkong dilakukan melalui beberapa tahapan. Pertama-tama disiapkan alat dan bahan, kemudian beras ketan dan singkong direndam selama 12 jam dan dikukus selama 60 menit. Setelah itu bahan ditiriskan selama 1 jam. Singkong dipotong-potong menjadi beberapa bagian. Kemudian ditambahkan ragi 1 gram dalam setiap 100 gram bahan. Selanjutnya ragi ditaburkan di atas beras ketan dan singkong lalu disimpan pada wadah yang telah dibungkus daun pisang dan ditutup rapat. Langkah terakhir, diinkubasi selama 4 hari dalam kondisi anaerob (Islami, 2018).

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Produk Roti

Roti merupakan makanan fermentasi berbahan dasar tepung terigu yang sering dikonsumsi masyarakat. Roti disebut sebagai produk fermentasi karena menggunakan ragi untuk pembentukan rasa dan aroma. Mikroba utama pada ragi roti adalah *Saccharomyces cerevisiae*. Ragi akan merombak gula membentuk gas karbondioksida dan alkohol. Gas karbondioksida akan terperangkap pada adonan yang menyebabkan adonan mengembang dan menghasilkan roti yang empuk (Sitepu, 2019).

Pembuatan roti dilakukan melalui beberapa langkah berikut ini. Bahan-bahan yang digunakan seperti tepung terigu, gula, garam dan mentega masing-masing ditimbang sesuai keperluan. Selanjutnya ragi roti ditimbang dan dicampurkan dengan air sebanyak 50 ml. Mentega dicampur dengan dua buah telur dan diaduk hingga rata, kemudian ditambahkan gula dan dicampurkan lagi hingga rata. Setelah itu tepung terigu dimasukkan sedikit demi sedikit sambil diaduk hingga campuran menjadi kalis. Selanjutnya susu cair 125 ml dan ragi roti yang telah direndam ditambahkan ke dalam adonan lalu diaduk hingga menjadi kalis. Setelah itu adonan diperam selama 40 menit lalu adonan dibentuk bulat-bulat dan diperam lagi selama 30 menit. Adonan kemudian dipanggang dengan suhu 70-75^{0}C selama 15 menit (Sitepu, 2019).

Pembuatan produk halal berbasis rekayasa genetika

Bioteknologi adalah aplikasi teknologi yang menggunakan organisme hidup untuk membuat atau memodifikasi produk atau proses untuk kegunaan khusus. Aplikasi bioteknologi modern adalah *Genetic Modification* (GM) yang diketahui sebagai teknik rekayasa genetik, manipulasi genetik dan teknologi gen atau teknologi rekombinan *Deoxyribonucleic Acid* (DNA) (Pramashinta *et al.*, 2014).

Rekayasa genetik digambarkan sebagai ilmu dimana karakteristik suatu organisme yang sengaja dimodifikasi dengan manipulasi materi genetik, terutama DNA dan transformasi gen tertentu untuk menciptakan variasi yang baru. Manipulasi DNA dan memindahkannya dari satu organisme ke organisme lain (disebut teknik rekombinan DNA) memungkinkan untuk memasukkan sifat dari hampir semua organisme pada tanaman, bakteri, virus atau hewan. Organisme transgenik saat ini diproduksi secara massal, seperti enzim, antibodi monoklonal, nutrien, hormon dan produk farmasi yaitu obat dan vaksin (Pramashinta *et al.,* 2014).

Bioetanol merupakan hasil dari proses fermentasi biomassa dengan bantuan mikroorganisme. Pada umumnya jenis mikroorganisme yang digunakan dalam produksi bioetanol adalah *Saccharomyces cerevisiae*. Hal tersebut dikarenakan *Saccharomyces cerevisiae* banyak ditemukan di alam, memiliki ketahanan hidup yang tinggi serta mampu menghasilkan alkohol dalam jumlah yang cukup tinggi (Jayus, *et al.,* 2016). Bioetanol mempunyai rumus molekul C_2H_5OH dengan rumus bangunnya CH_3-CH_2-OH. Bioetanol diproduksi dari biomassa yang mengandung gula, pati, dan selulosa (Arlianti, 2018). Bioetanol merupakan bahan bakar alternatif yang ramah lingkungan (Riyanti, 2010) karena titik nyala etanol tiga kali lebih tinggi dibandingkan bensin, dan memiliki emisi hidrokarbon yang lebih sedikit. Kekurangan bioetanol dibandingkan bensin adalah pada mesin dingin lebih sulit melakukan starter bila menggunakan bioetanol (Arliyanti, 2018).

Penelitian terbaru produksi bioetanol telah dilakukan melalui rekayasa genetik dengan menggunakan gen penyandi bioetanol. Rekayasa genetik untuk organisme penghasil bioetanol selain ragi yaitu menggunakan bakteri mesofilik dan termofilik yang menggunakan gen *Piruvat Dekarboksilase* (pdc) dan *Alkohol Dehidrogenase* (adh) dari berbagai sumber mikroorganisme. Bioetanol umumnya diproduksi dengan bantuan mikroorganisme jenis ragi (*Saccharomyces cerevisiae*) dengan sumber karbon gula sederhana dari molase, jagung atau tebu (Riyanti, 2010).

Titik kritis halal

Setiap produk dari bahan olahan harus diperhatikan titik kritis kehalalannya, mulai dari hulu hingga hilir. Titik kritis kehalalan merupakan celah yang dapat menjadi peluang masuknya bahan haram ke dalam produk halal sehingga menjadikan produk yang secara lahiriah halal menjadi haram untuk dikonsumsi. Demikian halnya dengan pemanfaatan *Saccharomyces cerevisiae* sebagai agen mikrobial utama untuk pembuatan produk berbasis bioteknologi. Fatwa MUI Nomor 1 tahun 2010 mengenai penggunaan mikroba dan produk mikrobial menjelaskan beberapa point utama yang

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menjelaskan terkait hal tersebut (MUI, 2010). Pertama, mikroba harus tumbuh pada media yang suci. Jika mikroba tersebut tumbuh pada media najis, apabila dapat dipisahkan antara mikroba dan media maka hukumnya halal setelah disucikan. Kedua, mikroba dan produk mikrobial yang memanfaatkan produk babi sebagai media pertumbuhan hukumnya haram. Selain pemilihan mikroba, penggunaan bahan baku maupun bahan campuran lain harus terjamin halalnya. Begitu pula tempat atau wadah untuk produksi harus terpisah dari tempat pengolahan babi dan turunannya.

KESIMPULAN

Berdasarkan penelusuran literatur yang telah dilakukan, *Saccharomyces cerevisiae* berperan penting dalam proses bioteknologi baik bioteknologi konvensional maupun bioteknologi modern. Berbagai produk halal yang dapat dibuat melalui proses fermentasi ataupun proses rekayasa genetika diantaranya roti, tape dan bioetanol yang digunakan sebagai bahan bakar alternatif yang ramah lingkungan.

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STUDI ILMIAH HALAL *FOOD ADDITIVE* YANG AMAN DIKONSUMSI DAN BAIK BAGI KESEHATAN

SCIENTIFIC STUDIES OF HALAL FOOD ADDITIVES FOR CONSUMPTION AND GOOD FOR HEALTH

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ABSTRAK

Food additive atau bahan tambahan pangan merupakan salah satu bahan yang umumnya sering digunakan oleh manusia untuk meningkatkan cita rasa, tekstur, kenampakan dan warna pada makanan. Penggunaan *food additive* bertujuan untuk meningkat kualitas produk akhir dan meningkatkan masa simpan bahan makanan. *Food additive* dapat berupa bahan sintetis atau alami yang berasal dari tumbuhan atau hewan. Menurut *World Health Organisation (WHO)* dan *Food and Agricultural Organisation (FAO)*, terdapat tiga kategori bahan tambahan yang diklasifikasikan berdasarkan fungsinya. Saat ini mayoritas masyarakat menggunakan bahan tambahan pangan ke dalam makanan secara berlebihan sehingga dapat berdampak pada menurunnya kesehatan manusia. Batas penggunaan *food additive* perlu diperhatikan agar tetap aman dikonsumsi dan tidak mengakibatkan gangguan kesehatan. Mayoritas industri *food additive* menggunakan bahan baku dari bahan sintetis sehingga apabila dikonsumsi secara berlebihan dapat berbahaya bagi kesehatan. Salah satu solusi yang dapat dilakukan adalah menggunakan bahan tambahan alami yang dapat diperoleh dari alam (*natural food additive).*

Kata kunci: *food additive,* aman*,* kesehatan, alami

ABSTRACT

Food additives are one of the ingredients commonly used by humans to improve the taste, texture, appearance and color of food. The use of food additives aims to improve the quality of the final product and increase the shelf life of food ingredients. Food additives can be synthetic or natural ingredients derived from plants or animals. According to the World Health Organization (WHO) and the Food and Agricultural Organization (FAO), there are three categories of additives classified based on their function. Currently the majority of people use food additives in their food excessively so that it can have an impact on decreasing human health. The limit for using food additives needs to be considered so that it is safe for consumption and does not cause health problems. The majority of the food additive industry uses raw materials from synthetic materials so that if consumed in excess it can be harmful to health. One solution that can be done is to use natural additives that can be obtained from nature (natural food additives).

Keywords: *food additive, safe, health, natural*

PENDAHULUAN

Sumber bahan yang terkandung didalam suatu produk sangat penting untuk umat islam dan harus teruji kehalalannya. Dalam perspektif persiapan makanan halal, LPPOM Majelis Ulama Indonesia telah mengembangkan standar pedoman halal yang komprehensif mencakup produksi, persiapan, penanganan, dan penyimpanan. Tujuan dari pedoman ini adalah untuk memastikan semua makanan yang diizinkan diproduksi dengan bebas risiko dan higienis yang berkaitan dengan hukum syariah (LPPOM MUI, 2014). Saat ini, perlu adanya pendalaman terkait kesadaran tentang konsep Halalan Toyyiban. Terdapat suatu keharusan bagi semua Muslim untuk memilih makanan yang berstatus Toyyib. Toyyib mengacu pada makanan yang aman, bersih, bergizi, dan berkualitas, atau bahan-bahannya aman untuk dikonsumsi, tidak beracun, tidak memabukkan, atau tidak berbahaya bagi kesehatan manusia. Dengan menekankan pada konsep ini, kualitas makanan yang diproduksi dapat dipastikan dan dapat memuaskan konsumen pada penggunaan produk ini dalam memenuhi kebutuhan dan harapan konsumen (Elassy, 2012; Halim *et.al.,* 2014). Dengan kemajuan rekayasa makanan, telah memungkinkan industri makanan untuk meningkatkan produksi makanan (Pyke, 2015; Koyratty *et.al.,* 2014). Salah satu rekayasa makanan yang perlu diperhatikan lebih mendalam adalah berkaitan dengan *Food additive* atau bahan tambahan pangan.

Codex Alimentarius (FAO/WHO, 2017) menjelaskan bahwa *food additive* adalah senyawa yang biasanya tidak dikonsumsi sebagai makanan dengan sendirinya dan biasanya tidak digunakan sebagai bahan baku utama dalam makanan tetapi sengaja ditambahkan dalam pembuatan, pengolahan, persiapan, perawatan, pengepakan, pengemasan, dan mengangkut makanan untuk melakukan fungsi teknologi (termasuk organoleptik). Bahan tambahan pangan bukanlah termasuk aditif atau kontaminan yang ditambahkan ke dalam makanan yang bertujuan untuk meningkatkan kandungan nutrisi dalam makanan. Penggunaan *food additive* bertujuan untuk meningkatkan kualitas produk akhir dan masa simpan bahan makanan secara eceran (Martins *et al.,* 2017). *Food additive* mempengaruhi karakteristik makanan ketika ditambahkan langsung selama pemrosesan makanan untuk tujuan tertentu (Atkins dan Smith, 1989; Turner, 1991). Tanpa bahan pengawet, pertumbuhan bakteri dapat menyebabkan produksi toksin yang dapat menyebabkan keracunan makanan (Saltmarsh dan Insall, 2013; Pandey dan Upadhyay, 2012).

Food additive dapat berupa sintetis yang berasal dari tumbuhan atau hewan dan telah dikelompokkan oleh *World Health Organisation* dan *Food and Agricultural Organisation* menjadi tiga kategori luas (*enhancer* rasa, enzim dan lainnya), yang didasarkan pada fungsinya (WHO, 2017). Penguat rasa merupakan mayoritas dari bahan tambahan pangan yang digunakan dalam makanan diantaranya adalah garam dan *monosodium glutamat*. Enzim meliputi bahan tambahan pangan yang mungkin menjadi protein alami atau senyawa sintetis yang membantu memecah molekul menjadi lebih kecil, seperti ragi yang digunakan dalam meningkatkan adonan atau untuk fermentasi alkohol. Bahan tambahan pangan lain termasuk nutrisi (gula) atau non-nutrisi (aspartame dan sakarin) pemanis dan bahan pengawet atau pewarna makanan. Industri makanan saat ini telah menggunakan sekitar 25 kelas bahan tambahan makanan, yang digunakan sesuai dengan undang-undang khusus dari masing-masing negara dan mengikuti kebijakan keamanan pangan, berdasarkan Codex Alimentarius Organisasi Pangan dan Pertanian Perserikatan Bangsa-Bangsa / Organisasi Kesehatan Dunia [FAO/WHO], 2016).

Secara umum, fungsi dasar dari bahan tambahan pangan adalah untuk membuat makanan terlihat lebih bagus, terasa lebih enak, membuat makanan lebih aman, dan mencegah oksidasi atau perubahan kimia lainnya (Saltmarsh dan Insall, 2013; Cole, 1986). Meskipun penggunaan bahan kimia berada di bawah yurisdiksi produsen, tetapi pihak lain seperti konsumen dan pihak berwenang harus secara proaktif memainkan peran mereka untuk memastikan bahan-bahan ini aman atau tidak berbahaya untuk dimakan (Cole, 1986). Hal ini dikarenakan beberapa produsen dapat berpotensi menggunakan bahan kimia yang tidak aman dalam produksi makanan mereka sehingga dapat menyebabkan penyakit. Berbagai jenis makanan yang tersedia saat ini mungkin mengandung beberapa bahan kimia yang dapat mempengaruhi kesehatan. Tidak hanya rasa makanan yang penting, tetapi juga penampilan makanan harus terlihat menarik (Senker, 1990). Penggunaan bahan tambahan pangan tidak hanya untuk memperbaiki penampilan dan rasa makanan tetapi juga daya tahannya (Koyratty *et.al*, 2014; Senker, 1990). Konsumen yang terpapar aditif makanan berbahaya dapat menyebabkan reaksi alergi kronis atau penyakit lainnya (Knowles *et. al.*, 2007). Masalah utama

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yang mengarah pada penelitian ini adalah sebagian besar struktur makanan telah dimodifikasi di mana beberapa zat aditif telah digunakan untuk meningkatkan daya tahan atau kesegaran makanan yang dapat menyebabkan implikasi negatif terhadap tubuh manusia. Bahan-bahan ini masih dianggap agen makanan tidak sehat yang dapat mengubah orisinalitas karakteristik makanan (Atkins dan Smith, 1989). Dengan jumlah yang besar dari bahan-bahan kimia ini, secara tidak langsung dapat berkontribusi terhadap implikasi kesehatan seperti penyakit kronis dalam jangka panjang (Knowles *et. al.*, 2007). Selain itu, konsumen umumnya tidak tahu mengenai peringkat keamanan bahan tambahan makanan dalam makanan olahan. Selain itu, masing-masing konsumen mungkin memiliki reaksi alergi yang berbeda dan setiap aditif makanan juga dapat memiliki reaksi yang berbeda terhadap tubuh manusia.

Tujuan dari penelitian ini adalah untuk memberikan informasi terkait *food additive* yang banyak digunakan pada makanan baik yang berasal dari bahan sintetis maupun bahan alami. Sehingga pada akhirnya konsumen dapat mengetahui jenis bahan kimia berbahaya yang sering ditambahkan pada makanan sehingga lebih waspada dalam memilih produk. Dalam perspektif Islam, tujuan ini dapat dicapai dengan memenuhi kriteria halalan toyyiban yang mencerminkan standar dan kualitas bahan makanan, di mana proses verifikasi dan sertifikasi keselamatan dan kesehatan berdasarkan sumber makanan dapat dilakukan.

FOOD ADDITIVE

The Food and Drug Administration of the United States (FDA) mendefinisikan *food additive* sebagai suatu zat yang ditambahkan pada makanan untuk menghasilkan karakteristik tertentu pada makanan. Sementara *European Food Safety Authority* (EFSA) mendeskripsikan *food additive* sebagai zat tidak dikonsumsi sebagai makanan dan hanya digunakan sebagai tambahan pada makanan pada saat pembuatan, pemrosesan, persiapan, perawatan, pengemasan, pengangkutan atau penyimpanan hasil makanan tersebut (EFSA, 2008; Saltmarsh and Insall, 2013).

Food additive dapat dibagi menjadi 6 kelompok yakni pengawet, zat tambahan nutrisi, zat pewarna, zat penyedap, zat tekstur dan zat agen. Selanjutnya, pengawet dibagi menjadi beberapa yaitu antimikroba, antioksidan, dan zat antibodi; zat pewarna meliputi senyawa azo, turunan *chinophthalon*, senyawa *triarylmethane, the xanthenes* dan indigos; agen penyedap meliputi pemanis, alami dan rasa sintetis dan penambah rasa. Sementara agen tekstur dibagi menjadi pengemulsi dan stabilisator (Carocho *et al.*, 2013).

BEBERAPA *FOOD ADDITIVE* BERBAHAYA BAGI KESEHATAN

Secara umum *food additive* digunakan sebagai tambahan pangan bukan sebagai bahan utama atau bahan baku. *Food additive* apabila dikonsumsi secara berlebihan akan membahayakan kesehatan. Salah satu *food additive* yang berbahaya adalah antimikroba yang seringkali digunakan dalam makanan seperti benzoat, sorbat, propionat, nitrit dan paraben. Meski dipelajari selama beberapa dekade, potensi efek berbahaya terhadap kesehatan masih ditemukan. Sodium benzoat merupakan salah satu zat yang memiliki efek berbahaya, meskipun dianggap aman, belum membuktikan bahwa itu tidak berbahaya dalam jangka panjang (Lennerz *et al.*, 2015). Tergantung pada dosis yang digunakan, sodium sorbat terbukti menjadi genotoksik pada limfosit darah in vitro (Mamur *et al.,* 2010). Studi ekstensif telah dilakukan selama bertahun-tahun tentang sorbat dan implikasi kesehatannya. Beberapa penelitian menggambarkan senyawa ini sebagai genotoksik dan mutagenik, sementara yang lain menyebut ini tidak relevan. Namun, kontroversi tetap ada, karena undang-undang, di mana natrium sorbat tidak diperbolehkan masuk AS, tetapi legal untuk digunakan dalam makanan di UE (Binstok *et al.*, 1998; Mpountoukas *et al.*, 2008; Mamur *et al.*, 2012). Nitrat (E240-E259) dan nitrit (E249-E250) adalah antimikroba lain yang lazim digunakan dalam bahan makanan. Nitrat baru-baru ini dibatasi di Uni Eropa, dan sekarang hanya dapat ditambahkan ke daging untuk penyembuhan secara lambat. Nitrit digunakan dalam daging untuk pembentukan warna, peningkatan rasa dan aktivitas antimikroba, menjadi satu-satunya makanan aditif untuk menghambat toksin botulinum. Mereka juga diizinkan dalam acar herring, sprat dan keju matang. Penggunaannya di Uni Eropa telah disetujui seminimal mungkin dosisnya. Nitrit dapat ditemukan dalam buah dan sayuran yang tidak diolah, dan dapat membentuk nitrosamin (Gøtterup *et al.*, 2007; Sebranek dan Bacus, 2007; Honikel, 2008; Watson dan Preedy, 2010; EU Reg. 1129/2011; Sindelar dan Milkowski, 2012;

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Iammarino *et al.*, 2013). Nitrit telah terbukti memiliki efek karsinogenik, di antaranya efek buruk lainnya terhadap manusia, yaitu oksidasi oksihemoglobin menjadi ferrihemoglobin (Cammack *et al.*, 1999). Sulfit atau zat sulfit digunakan dalam makanan seperti anggur, buah-buahan kering, biskuit kering, ikan, antara lain, untuk menghindari antimikroba kontaminasi. Mereka dikenal memiliki efek sitotoksik dan karsinogenik terhadap tikus dan manusia (Suh *et al.*, 2007; Iammarino *et al.*, 2012).

Selain antimikroba, *food additive* lain yang berpotensi membahayakan adalah beberapa zat antioksidan. Di antara antioksidan sintetik yang paling umum digunakan adalah *butylated hydroxyanisole, butylated hydroxytoluene, ethoxyquin, tert-butylhydroquinone* dan *propyl gallate*. Banyak studi telah dilakukan mengenai senyawa ini, dan sementara beberapa studi menunjukkan efek berbahaya seperti toksisitas dan efek karsinogenik, dan yang lain menunjukkan sebaliknya, menganggap mereka sebagai tumor supressant (Ikezaki *et al.*, 1996; Botterweck *et al.*, 2000; Bauer *et al.*, 2001; Vandghanooni *et al.*, 2013).

Pewarna makan seperti indigocarmine ditemukan berbahaya dengan memproduksi superoksida dismutase selama metabolisasi pada tikus (dosis antara 1 μM dan 100 μM) (Kohno *et al.*, 2005). *Safflower yellow* dan *kokum red* telah terbukti memiliki efek klastogenik pada sumsum tulang tikus (Agarwal *et al.*, 1994). Tartrazine, pewarna makanan yang tersebar luas diindikasikan mengalami cepat marah, gelisah dan gangguan tidur pada anak - anak (Rowe dan Rowe, 1994. Pemanis makanan seperti sakarin, aspartam, sukralose, dan asesulfame K adalah yang paling umum dan luas digunakan dalam industri makanan, terutama pada produk makanan rendah kalori. Mereka semua memberikan kekuatan pemanis pada dosis rendah. Sakarin dan sucralose dianggap sebagai aman untuk dikonsumsi dengan level maksimum yang ketat (EU Reg. 1129/2011), aspartam juga diindikasikan menimbulkan beberapa efek kontroversial, yaitu efek buruk pada bayi selama kehamilan, dan dengan menyebabkan stres oksidatif pada tikus wistar albino (Choudhary dan Rathinasamy, 2014; Toigo *et al.*, 2015). Acesulfame K telah terbukti dimiliki efek klastogenik pada tikus dan untuk menginduksi alergi pada manusia (dosis antara 15 dan 50 mg acesulfame Kg / berat badan) (Mukherjee dan Chakrabarti, 1997; Stohs dan Miller, 2014). Banyak lagi laporan tentang bahaya mengonsumsi *food additive* sintetis dapat ditemukan dalam literatur yang tersedia (Carocho *et al.*, 2014). Perhatian terhadap *food* additive sangat penting dan beberapa zat aditif jelas dikonsumsi berlebihan di wilayah Eropa, yaitu, sulfit (E220-228), nitrit (E249-250), polisorbat (E432-436), sukrosa ester dan sukrogliserida (E473-474), stearoil-2-laktilat (E481-482), sorbitan monolaureate dan sorbitan monooleate (E493-494), aluminium sulfat (E520-523), natrium aluminium fosfat (E541) dan aluminium silikat (E554- 556/559). Anak-anak dilaporkan lebih banyak mengonsumsi bahan aditif ini daripada orang dewasa.

KLASIFIKASI *FOOD ADDITIVE* ALAMI SEBAGAI PENGGANTI BAHAN TAMBAHAN BERBAHAYA

Antioksidan

Antioksidan pada makanan digunakan untuk mencegah rasa tidak enak akibat efek oksidasi lipid. Ada beberapa jenis antioksidan, yakni antioksidan primer yang dikenal sebagai antioksidan pemecah rantai; chelators, yang mengikat logam dan mencegah mereka dari memula formasi radikal; quencher, yang menonaktifkan spesies oksidan berenergi tinggi; *oxygen scavengers*, yang mengeluarkan oksigen dari sistem, menghindari destabilisasi sistem; dan regenerator antioksidan, yang meregenerasi antioksidan lain saat in menjadi teradikalisasi (Carocho *et. al.,* 2015). Untuk menghindari atau mengurangi kecepatan reaksi ini, industri makanan menambahkan zat antioksidan, yang bertujuan untuk menangkal radikal bebas dan oksigen, Antioksidan dapat mengurangi efek reaksi oksidasi dalam vitamin, pewarna alami dan komponen lipid (Damodaran dan Parkin, 2017). Makanan utama antioksidan adalah daging, minyak, gorengan, *dressing product*, produk susu, makanan yang dipanggang dan makanan ringan yang diekstruksi (Baines and Seal, 2012).

Semua antioksidan sintetik menghadirkan struktur kimia yang mirip dengan fenolik alami. Yakni senyawa, yang berpartisipasi dalam reaksi oksidasi melalui resonansi-distabilkan bentuk radikal bebas. Senyawa sintetis utama adalah butiran hidroksanisol, butylated hydroxytoluene dan butylhydroquinone (Belitz *et al.*, 2009). Namun, antioksidan sintetik semacam itu kurang disukai karena masalah toksikologis. Jadi, meningkatnya minat difokuskan pada identifikasi ekstrak tanaman sebagai sumber antioksidan. Penerapan antioksidan dalam bahan makanan meningkatkan umur

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simpan. Namun, penggunaannya harus dinilai dan dipantau dengan cermat, karena menyebabkan toksisitas, menghasilkan pembentukan senyawa beracun dalam makanan yang bisa terakumulasi didalam tubuh dan menyebabkan masalah kesehatan, seperti penyakit degeneratif.

Polifenol adalah beberapa kelompok senyawa alami yang terkandung pada tanaman (Carocho dan Ferreira, 2013). Ekstrak polifenol seperti rosemary dan ekstrak lain dari tanaman telah digunakan sebagai antioksidan dalam makanan dan digunakan sebaga bahan tambahan makanan dengan nomor E 392. Asam karnat, turunan asam hidroksibenzoat, adalah konstituen yang dikenal dari ekstrak rosemary dan diyakini memiliki efek antioksidan paling penting di dalamnya. Zat ini digunakan didalam minyak, lemak hewani, saus, roti, roti daging (antara 22,5 dan 130 ppm untuk roti daging) dan ikan, antara lain (Naveena *et al.,* 2013; Bitrić *et al.,* 2015). Asam ferulic, asam hidroksikinamat, juga digunakan dalam industri makanan sebagai antioksidan dan pelopor bahan pengawet lainnya, serta mengambil bagian dalam gel makanan (Kumar dan Pruthi, 2014; Ou dan Kwon, 2004).

Karoten juga dikenal karena potensi antioksidannya sebagai zat tambahan makanan, meskipun penggunaannya selalu terbatas karena sangat rentan terhadap oksidasi oleh cahaya. Lycopene (E-160d) adalah karotenoid yang paling banyak ditemukan terutama dalam tomat, meskipun tidak banyak digunakan sebagai antioksidan makanan. Di sisi lain, β-karoten digunakan dalam makanan yang dipanggang, telur, dan produk susu, antara lain, sebagai pendingin oksigen singlet (Smith dan HongShum, 2011). Pada banyak bahan makanan yang menggunakan karoten, asam askorbat dan vitamin E (tokoferol) digabungkan dan dicampurkan. Campuran karoten dan β-karoten telah ditinjau oleh panel ilmiah EFSA dan mampu menetralisir toksisitas apa pun, baik dari bahan sintetis atau ekstraksi dari tanaman dan buah-buahan (EFSA, 2012).

Tokoferol, yang merupakan bahan penyusun vitamin E, juga dikenal sangat kuat antioksidannya. Tokoferol dapat bersinergi dengan asam askorbat melalui proses regenerasi. Terlepas dari itu, fungsi antioksidan utama mereka adalah dengan mengakhiri radikal bebas dalam reaksi autoksidasi (Smith dan Hong-Shum, 2011). Dalam beberapa kasus tokoferol digunakan dalam film dan pelapis (Barbosa-Pereira *et al.*, 2013; Lin dan Pascall, 2014; Marcos *et al.*, 2014), meskipun mereka dapat digunakan sebagai aditif juga (E- 306 hingga E-309). Senyawa ini telah digunakan dalam bacon (300 mg / kg), daging, susu produk dan minyak, antara lain (Smith dan Hong-Shum, 2011; Wang *et al.*, 2015).

Antimikroba

Penggunaan bahan pengawet berupa antimikroba dapat digunakan untuk meningkatkan masa simpan pada bahan makanan, tetapi pada konsentrasi tinggi, senyawa ini dapat menyebabkan rasa tidak enak, bau menyengat, perubahan viskositas dan retensi warna, serta penurunan kelarutan. Industri makanan menggunakan bahan pengawet atau antimikroba, yang bisa jadi digunakan untuk menghambat reaksi kecoklatan non-enzimatik dan reaksi katalis, dan reaksi pembelahan reversibel protein (sulfit dan sulfur dioksida). Di industri daging, garam natrium dan kalium dari nitrit dan nitrat sering digunakan untuk mengawetkan. Dalam industri keju dan yoghurt, bahan pengawet benzoat, sorbat, dan natamycin digunakan untuk menghambat pertumbuhan bakteri dan jamur yang tidak diinginkan. Pengawet berfungsi untuk mempertahankan kualitas produk dan meningkatkan kualitas gizi (Damodaran dan Parkin, 2017).

Sweetener

Pemanis adalah senyawa kimia yang digunakan untuk menambah rasa manis. Pemanis buatan atau pemanis non-gizi sering digunakan sebagai alternatif gula. Dalam beberapa dekade terakhir, ada pertanyaan mengenai kesehatan implikasi diet yang tinggi gula, terutama gula rafinasi. Meski secara dampak kesehatan tidak terlalu signifikan, penggunaan gula yang berlebihan telah dikaitkan peningkatan risiko penyakit kardiovaskular (Brown *et al.*, 2008; Stanley *et al.*, 2009), diabetes mellitus (Apovian, 2004; Gross *et al.*, 2004), obesitas, kognitif menurun (Lakhan dan Kirchgessner, 2013; Chiavaroli *et al.*, 2014) dan kerusakan gigi (Zero *et al.*, 2009; Jacob *et al.*, 2016). Diet yang tinggi gula dapat menyebabkan meningkatkan lemak dalam tubuh dan menyebabkan obesitas.

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Pemanis steviol glikosida (E 960) adalah contoh senyawa alami dengan penyebaran tinggi di seluruh dunia (EFSA, 2014). Salah satu jenis glikosida adalah *steviosides* dan *rebaudiosides* yang juga sering dikenal sebagai stevia, stevioside atau steviol. Karena memiliki berbagai senyawa dalam formulanya, steviol glikosida memiliki potensi yang berbeda, dengan paling rendah 30 kali lebih manis daripada sukrosa (dulcoside A, rebaudioside C) dan yang lain sekitar 300 kali lebih kuat (rebaudioside A). Steviol glikosida telah disetujui sebagai pemanis di banyak negara, termasuk UE dan AS, dengan hasil yang luar biasa mengenai toksisitas, kariogenisitas, karsinogenisitas, dan alergireaksi. Di industri makanan, glikosida steviol digunakan dalam minuman, susu produk, es krim, makanan penutup beku, gula-gula, permen, makanan laut kering dan saus. Pada 2014, glikosida steviol diteliti oleh EFSA dan menetapkan bahwa konsumsi bahan ini tidak menimbulkan ancaman toksikologis sebagai aditif makanan (Brandle *et al.*,1998; O'Brien-Nabors, 2001; Brusick, 2008; Baines and Seal, 2012; EFSA, 2014; Urban *et al.*, 2015).

Pemanis berpotensi tinggi lainnya adalah glycyrrhizin (E 958) (Barclay *et al.*, 2014), triterpen glikosida diekstraksi dari tanaman Glycyrrhiza glabra L. (Liquorice). Senyawa ini, juga dikenal sebagai asam glycyrrhizic yang dapat digunakan sebagai pemanis dengan potensi 50 kali lebih manis daripada sukrosa, tetapi juga sebagai pengantar dan penambah busa pada minuman atau makanan. Senyawa ini secara legal digunakan di AS dan UE dalam bentuk monoammonium glycyrrhizinate dan glycyrrhizin yang teramoniasi. Senyawa ini digunakan pada makanan panggang, produk susu beku, minuman, gula-gula dan permen karet (O'Brien-Nabors, 2001; Spillane, 2006; Baines and Seal, 2012).

Pemanis potensi tinggi lainnya adalah Thaumatin. Thaumatin ini diekstrak dari buah *Thaumatococcus daniellii,* tanaman asli Afrika. Tidak ada nilai konklusif dari potensinya; beberapa penulis menganggapnya sekitar 1600 kali lebih kuat dari sukrosa, sementara yang lain menunjukkan nilai di atas 3000. Karena terlalu manis, thaumatin tidak direkomendasikan digunakan dengan jumlah yang banyak, meskipun sangat berguna untuk dicampur dengan pemanis lain untuk memberi rasa umami dan untuk mengurangi rasa pahit pada bahan makanan. Makanan utama yang sering ditambahkan thaumatin sebagai pemanis atau penambah rasa adalah saus, sup, jus buah, produk unggas, produk telur, permen karet, dan sayuran olahan (O'Brien-Nabors, 2001; Baines dan Seal, 2012). Neohesperidin dihydrochalcone, pemanis yang banyak digunakan di Uni Eropa (E959) dan AS (GRAS), yang disintesis dari neohesperidin atau naringin adalah dianggap sebagai senyawa sintetis, meskipun asalnya dari senyawa buah jeruk. Senyawa ini 1500 kali lebih kuat daripada sukrosa dan digunakan dalam jus, selai, permen karet, gula-gula dan susu (O'Brien-Nabors, 2001; Spillane, 2006; Baines and Seal, 2012; El-Samragy, 2012). Ada beberapa pemanis alami lain yang bisa digunakan di masa depan, tetapi tidak memiliki aplikasi dalam bahan makanan pada saat ini. Contoh dari senyawa tersebut adalah monatin dan brazzein. Hal ini dikarenakan kelangkaan bahan baku dan hasil panen yang buruk ketika diisolasi dari matriks tanaman.

Pewarna Alami

Pewarna digunakan dalam makanan untuk meningkatkan kenampakan makanan agar terlihat lebih menarik dan menggugah selera. Pewarna digunakan untuk meningkatkan warna pada makanan dan secara kenampakan mudah dihilangkan selama masa simpan. Pewarna makanan dapat diklasifikasikan menjadi tiga kelompok; pewarna makanan alami, yang merujuk pada pewarna yang disintesis secara alami; identik dengan alam pewarna, yang meskipun disintesis dalam industri, yang alami dan akhirnya pewarna buatan (Msagati, 2013).

Ada banyak pewarna makanan dari alam yang digunakan di industri makanan. Misalnya paprika yang memiliki campuran dari dua karotenoid, capsanthin dan capsorubin. Baan ini disetujui di UE (E160c) dan menampilkan warna oranye ke merah (Hendry dan Houghton, 1996). Ada banyak karoten lain yang digunakan dalam makanan yaitu *β-karoten, lutein, violaxanthin, neoxanthin, β-cryptoxanthin, fucoxanthin, lycopene* dan *astaxanthin.* Mereka diekstraksi dari tanaman, ganggang dan bahkan serangga dan mewakili luas spektrum warna dalam industri makanan. Aplikasi utama karoten dalam makanan terkait dengan saus, bumbu-bumbu, campuran rempah-rempah, pelapis, minuman, susu (Baines and Seal, 2012). Antosianin (E 163) bertanggung jawab atas pigmen di alam, yaitu merah, ungu, ungu dan biru dan ini dapat dialihkan ke makanan ketika digunakan sebagai pewarna. Antosianin utama di alam adalah sianida, delphinidin, malvinidin, pelargonidin, peonidin, petunidin, menjadi aplikasi utama mereka dalam bentuk minuman, produk manisan dan olahan buah (Hendry

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dan Houghton, 1996; Baines and Seal, 2012). Pada 2013, EFSA mensyaratkan pendapat ilmiah tentang keamanan konsumsi mereka sebagai aditif makanan, yang menyimpulkan bahwa penelitian lebih lanjut harus dilakukan dilakukan karena kurangnya data toksikologis (EFSA, 2013).

KESIMPULAN

Food additive dapat berasal dari bahan sintetis dari tumbuhan atau hewan dan diklasifikasikan menjadi beberapa macam. Penguat rasa seperti garam dan *monosodium glutamat* merupakan bahan tambahan yang digunakan dalam makanan. Enzim merupakan bahan tambahan pangan yang membantu memecah molekul menjadi lebih kecil, seperti ragi yang digunakan dalam adonan atau untuk fermentasi alkohol. Selain itu terdapat juga bahan tambahan pangan lain seperti pemanis, bahan pengawet, dan pewarna makanan. Mayoritas industri menggunakan bahan tambahan pada pangan dari bahan sintetis yang berpotensi berbahaya bagi kesehatan apabila dikonsumsi secara berlebihan. Salah satu solusi untuk mengurangi konsumsi bahan tambahan sintetis adalah dengan menggunakan bahan tambahan alami yang lebih aman dikonsumsi dan tidak memiliki efek buruk pada kesehatan dalam jangka waktu panjang. Bahan tambahan alami yang dapat digunakan sebagai alternatif pengganti bahan sintets diantaranya antioksidan, antimikroba, pemanis, dan pewarna alami.

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AKTIVITAS ANTIOKSIDAN EKSTRAK ETANOL HERBA PEGAGAn (*Centella asiatica* (L.) Urban) DENGAN METODE DPPH (*2,2-Difenil-1-Pikrilhidrazil*)

ANTIOXIDANT ACTIVITY ETHANOL EXTRACT OF GOTU KOLA (Centella asiatica (L.) Urban) WITH DPPH METHOD (2,2-Diphenyl-1-Pikrilhidrazil)

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ABSTRAK

Pola hidup yang tidak sehat dan polusi udara menyebabkan jumlah radikal bebas dalam tubuh meningkat. Untuk melindungi tubuh dari radikal bebas terdapat senyawa antioksidan sebagai penangkal dan menstabilkan radikal bebas. Salah satu tumbuhan Indonesia yang bisa dimanfaatkan sebagai antioksidan adalah pegagan (*Centella asiatica* (L.) Urban. Penelitian ini bertujuan untuk mengetahui aktivitas antioksidan dari ekstrak etanol herba pegagan dengan metode DPPH (*2,2-Difenil-1-pikrilhidrazil*) yang dinyatakan dengan nilai IC_{50}. Metode penelitian ini adalah pegagan (*Centella asiatica* (L.) Urban) diekstraksi dengan metode soxhletasi menggunakan pelarut etanol 96%. Pengujian aktivitas antioksidan dilakukan dengan metode DPPH (*2,2 Difenil-1-Pikrilhidrazil*). Hasil pengujian aktivitas antioksidan pada ekstrak etanol herba pegagan menunjukkan nilai IC_{50} sebesar 78,20 ppm. Hal ini menunjukkan bahwa ekstrak etanol herba pegagan termasuk dalam kriteria antioksidan kuat.

Kata kunci: Antioksidan, DPPH, $IC_{50,}$ Pegagan (*Centella asiatica* (L.) Urban

ABSTRACT

Unhealthy lifestyles and air pollution cause the number of free radicals in the body to increase. To protect the body from free radicals, there are antioxidant compounds as an antidote and stabilize free radicals. One of the Indonesian plants that can be used as antioxidants is gotu kola (Centella asiatica (L.) Urban. Objective: This study aims to determine the antioxidant activity of the ethanol extract of gotu kola herb using the DPPH (2,2-Diphenyl-1-pikrilhidrazil) method. with IC_{50} value. Method: Gotu kola (Centella asiatica (L.) Urban) was extracted by the soxhletation method using 96% ethanol solvent. The testing of antioxidant activity was carried out using the DPPH (2.2 Diphenyl-1-Pikrihydrazil) method. Result: Test results of antioxidant activity The ethanol extract of gotu kola herb showed an IC_{50} value of 78.20 ppm. Conclusion: This indicated that the ethanol extract of gotu kola herb was included in the criteria for strong antioxidants.

Keywords: *Antioxidant, DPPH, IC_{50}, Gotu Kola* (*Centella asiatica* (L.) Urban

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PENDAHULUAN

Pola hidup yang tidak sehat dan polusi udara dapat menyebabkan jumlah radikal bebas di dalam tubuh meningkat (Dominica and Handayani, 2019). Untuk melindungi tubuh dari radikal bebas, terdapat suatu senyawa antioksidan yang dapat menangkal dan menstabilkan radikal bebas (Julfitriyani *et al*., 2016).

Antioksidan adalah suatu senyawa yang dapat melindungi sel dari kerusakan yang disebabkan radikal bebas. Antioksidan akan berinteraksi dengan cara menstabilkan radikal bebas sehingga dapat mencegah kerusakan karena radikal bebas yang mungkin dapat terjadi (Hamid *et al.*, 2010). Salah satu

tumbuhan Indonesia yang bisa dimanfaatkan untuk tujuan tersebut adalah herba pegagan (*Centella asiatica* (L.) Urban). Herba Pegagan merupakan tanaman liar yang banyak tumbuh di berbagai tempat seperti di ladang, perkebunan maupun di pekarangan (Yusran *et al.* 2016). Herba Pegagan memiliki kandungan senyawa seperti polifenol, β karoten, tanin, vitamin C dan saponin seperti Madecassida dan Asiaticosida. Asiaticosida yang terdapat pada pegagan berfungsi sebagai antioksidan yang dapat menangkap radikal bebas, merevitalisasi pembuluh darah dan memperbaiki daya ingat (Anggraini *et al.* 2014).

Aktivitas antioksidan daun pegagan yang telah diteliti dalam penelitian sebelumnya menggunakan metode maserasi dengan pelarut metanol menunjukkan bahwa daun pegagan memiliki nilai IC_{50} sebesar 481,64 ppm (Wientarsih *et al*., 2013). Salah satu metode uji aktivitas antioksidan yang sering digunakan adalah metode DPPH (*2,2-Diphenyl-1-Picrylhydrazyl*). Mekanisme kerja dari metode DPPH adalah mereaksikan antioksidan yang terdapat pada sampel dengan DPPH dimana antioksidan akan mendonorkan atom hidrogennya sehingga akan menghambat aktivitas dari radikal bebas (Sitorus dkk*.,* 2013). Oleh karena itu dilakukan penelitian ini dengan tujuan untuk menguji aktivitas antioksidan ekstrak etanol herba pegagan (*Centella asiatica* (L.) Urban) dengan metode DPPH (*2,2-Diphenyl-1-Picrylhydrazyl*) yang dinyatakan dengan nilai IC_{50}.

METODE PENELITIAN

Bahan dan Alat

Bahan yang digunakan yaitu simplisia pegagan, vitamin C, metanol p.a, DPPH (*2,2-diphenyl-1-picrylhydrazyl*), etanol 96%, aquadest, kloroform, HCl 0,5 N, pereaksi Mayer, Bauchardat, amonia 25%, $FeCl_3$. Adapun alat yang digunakan yaitu satu set alat ekstraksi soxhlet, rotary evaporator, spektrofotometer UV-Vis, timbangan analitik, kuvet, serta berbagai alat gelas yang biasa digunakan di Laboratorium.

Metode

Pembuatan Ekstrak Etanol Herba Pegagan

Ekstraksi dilakukan dengan metode soxhletasi. Serbuk pegagan sebanyak 400 gram dibagi menjadi 4 bagian sama banyak, proses sokletasi dilakukan sebanyak 4 kali. Serbuk pegagan diekstraksi dengan etanol 96% menggunakan alat soxhlet pada suhu 60-80^oC. Kemudian ditunggu hingga zat aktif dalam simplisia tersari seluruhnya yang ditandai dengan jernihnya cairan yang lewat tabung sifon. Cairan yang diperoleh dari 4 kali sokletasi selanjutnya diuapkan dengan rotary evaporator pada suhu 60^oC sampai diperoleh ekstrak kental (Nurrosyidah *et al.* 2019).

Skrining Fitokimia

1. Identifikasi Sterol dan Triterpenoid. Sebanyak 0,5 gram ekstrak kental dilarutkan dalam kloroform, kemudian disaring dan filtrat diuji dengan uji Salkowski yaitu filtrat ditambahkan beberapa tetes asam sulfat pekat dan diamati perubahan warna yang terjadi. Warna merah di lapisan bawah positif sterol dan warna kuning keemasan menunjukkan adanya triterpenoid (Abdillah *et al*., 2017).
2. Identifikasi Alkaloid. Ekstrak kental dimasukkan ke dalam masing-masing tabung reaksi kemudian ditetesi: (a) HCl 0,5 N dan pereaksi Mayer, jika mengandung alkaloid maka akan menghasilkan endapan kuning. (b) HCl 0,5 N dan pereaksi Bauchardat, jika mengandung alkaloid maka akan menghasilkan endapan coklat (Syarif *et al.* 2015).
3. Identifikasi Flavonoid. Ekstrak kental ditambahkan amonia 25%. Jika mengandung flavonoid akan berwarna kuning kehijauan (Nurrosyidah *et al*., 2019).
4. Identifikasi Saponin. Sebanyak 0,5 gram ekstrak dilarutkan dalam 5 ml air suling lalu dikocok dan diamati terbentuknya buih stabil (Abdillah dkk., 2017).
5. Identifikasi tanin. Ekstrak kental ditambahkan beberapa tetes $FeCl_3$, jika mengandung tanin akan berwarna hijau, biru sampai hitam (Nurrosyidah *et al.* 2019).

Pengujian Aktivitas Antioksidan Dengan Metode DPPH (*2,2-Diphenyl-1-Picrylhydrazyl*)

1. Pembuatan Larutan DPPH. Pembuatan larutan DPPH 100 ppm dibuat dengan cara menimbang DPPH sebanyak 5 mg kemudian ditambahkan metanol p.a hingga 50 mL.

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2. Penentuan Panjang Gelombang Serapan Maksimum DPPH. 1 mL larutan DPPH 100 ppm dimasukkan ke dalam tabung reaksi, selanjutnya ditambahkan 3 ml metanol p.a dan dihomogenkan. Diinkubasi pada suhu ruang selama 30 menit. Selanjutnya ditentukan panjang gelombang optimumnya, diukur absorbansinya pada panjang gelombang 510-525 nm (Syaifuddin, 2015).
3. Pembuatan Larutan Sampel Ekstrak Pegagan. Ditimbang ekstrak pegagan sebanyak 25 mg, kemudian dilarutkan dalam 25 mL metanol p.a, dimasukkan dalam labu ukur sehingga diperoleh larutan induk 1000 ppm. Dari larutan induk dibuat seri konsentrasi menjadi 4, 8, 12, 16, 20 dan 100 ppm.
4. Pembuatan Larutan Vitamin C sebagai Pembanding. Ditimbang Vitamin C sebanyak 5 mg. Dilarutkan dengan metanol p.a secukupnya, dimasukkan ke dalam labu ukur 50 ml lalu ditambahkan metanol p.a hingga 50 ml, sehingga diperoleh konsentrasi sebesar 100 ppm. Dari larutan induk dibuat seri konsentrasi menjadi 2, 4, 6, 8 dan 10 ppm.
5. Pengukuran Serapan dengan spektrofotometer UV-Vis. Masing-masing larutan sampel dan larutan pembanding, dipipet 1 mL, dimasukkan ke dalam tabung reaksi, ditambahkan 1 mL DPPH 100 ppm dan ditambahkan 2 mL metanol p.a, dikocok hingga homogen. Larutan ini diinkubasi pada suhu ruang selama 30 menit dan diukur serapannya pada panjang gelombang optimum DPPH yang diperoleh. Dilakukan replikasi sebanyak 3 kali.
6. Penentuan % Inhibisi dan Nilai IC_{50}

   % Inhibisi = $\frac{\text{Abs blanko} - \text{Abs sampel}}{\text{Abs Blanko}} \times 100\%$

   Nilai IC_{50} dihitung menggunakan persamaan regresi linier dari y = bx + a antara konsentrasi larutan uji (x) dengan % Inhibisi (y).

HASIL DAN PEMBAHASAN

Ekstraksi Pegagan

Proses pembuatan ekstrak pegagan dilakukan dengan menggunakan metode soxhletasi. Metode ini dipilih karena memiliki keuntungan diantaranya jumlah pelarut yang digunakan lebih sedikit serta komponen yang diekstraksi dapat tersaring sempurna karena dilakukan sirkulasi berkali-kali (Putri, 2018). Sedangkan untuk pelarut yang digunakan adalah etanol 96%. Pemilihan pelarut etanol 96% tersebut didasarkan pada kemudahannya saat diuapkan serta sifatnya yang mampu melarutkan hampir semua zat, baik yang bersifat polar, semi polar dan nonpolar (Sulastri dkk., 2015). Adapun hasil yang diperoleh dari ekstraksi pegagan dapat dilihat pada Tabel 1 berikut.

Tabel 1. Hasil Ekstraksi Pegagan

Sampel	Bobot simplisia	Bobot Ekstrak	Rendemen
Pegagan	400 gram	50 gram	12,5%

Skrining Fitokimia

Ekstrak pegagan yang sudah diperoleh selanjutnya dilakukan pengujian fitokimia untuk mengetahui kandungan metabolit sekunder yang terkandung didalam ekstrak pegagan. Pengujian fitokimia yang dilakukan meliputi sterol, triterpenoid, alkaloid, flavonoid saponin dan et al.,. Hasil pengujian fitokimia dapat dilihat pada Tabel 2 berikut.

Tabel 2. Skrining Fitokimia Ekstrak Pegagan

No	Metabolit Sekunder	Hasil	Keterangan
1	Triterpenoid	-	Tidak terbentuk warna kuning keemasan
2	Sterol	+	Terbentuk warna merah
3	Alkaloid	+	Terbentuk endapan kuning (Mayer) Terbentuk endapan coklat (Et al.,)
4	Flavonoid	+	Terbentuk warna kuning kehijauan

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5	Saponin	+	Terbentuk busa yang stabil
6	Et al.,	+	Terbentuk warna biru kehitaman

Keterangan: (+) = mengandung senyawa yang diuji
(-) = tidak mengandung senyawa yang diuji

Dari tabel tersebut dapat diketahui ekstrak etanol herba pegagan positif mengandung senyawa sterol, alkaloid, flavonoid, saponin dan et al.,. Sedangkan pada pengujian triterpenoid diperoleh hasil yang negatif karena sampel tidak mengalami perubahan warna yang sesuai dengan indikator.

Uji Aktivitas Antioksidan Metode DPPH

Pengujian aktivitas antioksidan dilakukan dengan menggunakan metode DPPH. Pemilihan metode ini karena merupakan metode yang sederhana, mudah, cepat dan serta hanya memerlukan sedikit sampel untuk evaluasi aktivitas antioksidan. Larutan radikal bebas DPPH memiliki atom nitrogen yang tidak berpasangan. Reaksi DPPH dengan atom hidrogen yang terdapat dalam antioksidan dapat membuat larutan DPPH menjadi berkurang reaktivitasnya yang ditunjukkan dengan memudarnya warna ungu menjadi kuning (Amanda *et al.* 2019). Sebagai pembanding pada penelitian ini digunakan vitamin C. Alasan penggunaan vitamin C sebagai pembanding, karena vitamin C merupakan antioksidan sekunder yang dapat menangkap radikal bebas, mencegah terjadinya reaksi berantai dan aktivitas antioksidannya tinggi. Vitamin C mempunyai gugus hidroksil yang bertindak sebagai penangkap radikal bebas (Isnindar *et al.* 2011).

Pengujian aktivitas antioksidan dilakukan dengan membuat larutan DPPH yang selanjutnya dilakukan penentuan panjang gelombang maksimumnya. Proses penentuan panjang gelombang maksimum ini bertujuan untuk mendapatkan panjang gelombang yang memiliki absorbansi maksimal. Penentuan panjang gelombang ini dilakukan pada rentang 510-525 nm Hasil penentuan panjang gelombang maksimum DPPH yang didapat adalah 515 nm. Setelah diperoleh panjang gelombang maksimum, tahap selanjutnya yaitu pengukuran absorbansi sampel setiap konsentrasi serta perhitungan % inhibisi. Hasil pengukuran absorbansi dan % inhibisi yang diperoleh dapat dilihat Table 3 dan Tabel 4 berikut.

Tabel 3. Hasil Absorbansi dan % Inhibisi Ekstrak Etanol Herba Pegagan.

Sampel	Konsentrasi (ppm)	Absorbansi Blanko	Absorbansi Sampel*	% Inhibisi*
Ekstrak Pegagan	4	0,711	0,628	11,67%
	8		0,625	12,09%
	12		0,619	12,93%
	16		0,616	13,36%
	20		0,610	14,20%
	100		0,264	62,86%

Keterangan: * = Pengukuran dilakukan sebanyak 3 kali

Tabel 4. Hasil Absorbansi dan % Inhibisi Vitamin C.

Sampel	Konsentrasi (ppm)	Absorbansi Blanko	Absorbansi Sampel*	% Inhibisi*
Ekstrak Pegagan	2	0,711	0,655	7,87%
	4		0,603	15,18%
	6		0,570	19,83%
	8		0,550	22,64%
	10		0,491	30,94%

Keterangan: * = Pengukuran dilakukan sebanyak 3 kali

Berdasarkan tabel 3 dan 4 dapat diketahui semakin besar konsentrasi larutan sampel maka semakin kecil nilai absorbansi yang diperoleh. Semakin kecil nilai absorbansi maka akan semakin besar nilai % inhibisi. Hal ini dikarenakan semakin tinggi konsentrasi larutan maka aktivitas antioksidannya semakin

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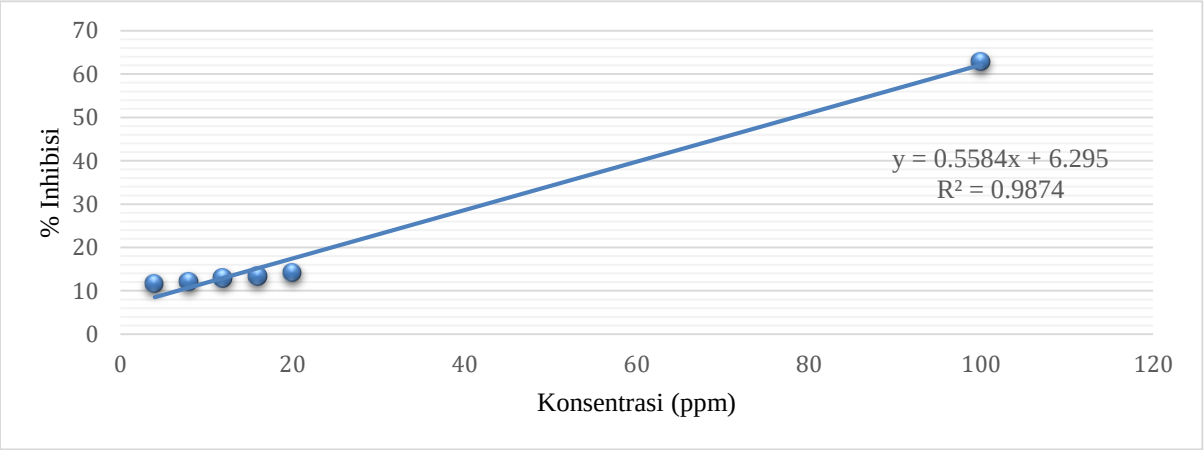
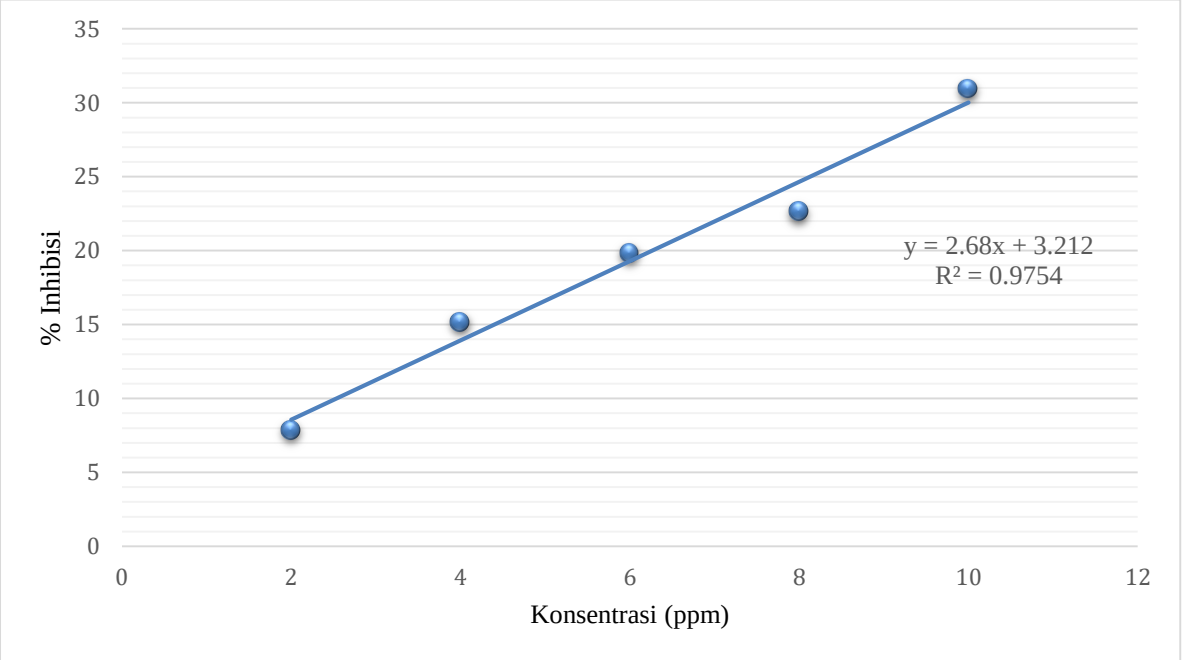
tinggi. Setelah mendapatkan data % inhibisi selanjutnya dibuat persamaan regresi linier antara konsentrasi larutan (x) dan % inhibisi (y). Hasil persamaan regresi larutan sampel dapat dilihat pada gambar 1 dan gambar 2 berikut.

Gambar 1. Persamaan Regresi Linier Ekstrak Etanol Herba Pegagan



Gambar 2. Persamaan Regresi Linier Vitamin C



Persamaan regresi linier yang sudah didapat selanjutnya dilakukan perhitungan nilai IC_{50}. Nilai IC_{50} merupakan konsentrasi senyawa antioksidan yang dibutuhkan untuk menangkap radikal bebas DPPH sebanyak 50%. Semakin kecil nilai IC_{50} maka semakin besar aktivitas antioksidannya. Hasil perhitungan nilai IC_{50} dapat dilihat pada Tabel 5.

Tabel 5. Nilai IC_{50} Ekstrak Etanol Herba Pegagan dan Vitamin C

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Sampel	Nilai IC_{50}
Ekstrak Pegagan	78,26 ppm
Vitamin C	17,45 ppm

Menurut Andriani *et al.* (2015) dalam Syafrinal dan Sari Ramadhani (2019) aktivitas antioksidan suatu senyawa dapat digolongkan menjadi antioksidan sangat kuat jika nilai IC_{50} kurang dari 50 ppm, dikatakan kuat jika nilai IC_{50} 50-100 ppm, dikatakan sedang jika nilai IC_{50} 100-150 ppm, dikatakan lemah jika nilai IC_{50} 150-200 ppm dan sangat lemah jika nilai IC_{50} lebih dari 200 ppm. Berdasarkan kriteria tersebut ekstrak pegagan termasuk dalam kriteria antioksidan kuat dan vitamin C termasuk dalam kriteria antioksidan sangat kuat.

Berdasarkan hasil uji aktivitas antioksidan dapat diketahui bahwa aktivitas antioksidan ekstrak pegagan lebih rendah jika dibandingkan dengan vitamin C. Rendahnya aktivitas antioksidan tersebut diduga disebabkan oleh berbagai faktor, diantaranya karena metode ekstraksi yang digunakan diduga tidak cukup menarik komponen kimia yang bersifat antioksidan dalam pegagan. Selain itu diduga karena vitamin C merupakan zat atau senyawa tunggal yang memiliki aktivitas antioksidan sangat kuat sedangkan pada ekstrak senyawa masih dalam bentuk kompleks atau masih gabungan antara komponen-komponen senyawa lain.

KESIMPULAN

Berdasarkan penelitian yang dilakukan dapat disimpulkan bahwa ekstrak etanol herba pegagan memiliki aktivitas antioksidan dengan nilai IC_{50} sebesar 78,26 ppm yang tergolong dalam antioksidan kuat.

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