Mini Review

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Meeting the requirements of halal gelatin: A mini review

Abstract

Gelatin is a traditional functional protein with water-soluble properties and has the potential of forming transparent gels under certain conditions. The major source of gelatin is pigskin and is using in processed food and medicinal products. Though the use of food products adulterated with porcine-derived gelatin create concerns in the mind of Muslim communities, as in Islam; it is not acceptable or literally, it is called Haram in Islam Religion. However, in recent times initiatives have been taken in producing gelatin from Halal sources, such as fish, chicken and bovine slaughtered according to Islamic teachings. Therefore, we highlighted different porcine alternative derived gelatin sources and also methods to detect edible product contents pork or other haram stuff. This review could be useful in providing information to a large number of readers and food processing companies to minimize or if possible eradicate the use of porcine-derived gelatin in commercial food and medicinal products.

Keywords: gelatin, muslim, halal, fish, chicken, islam, religion

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Introduction

Gelatin is a fibrous protein with high molecular weight, derived from collagen which comprises about 25 to 35% of total body protein, through thermal hydrolysis.[1,2] It is the main protein connective tissue and widely found in mammals, birds and fishes.[3,4] In general, gelatin plays a vital role in food processing and formulation (i.e., gelling process and some respond to the surface behavior of gelatin).[5] The other functional properties of gelatin are of foaming, emulsifying, setting index and water holding capacity.[4] Gelatin has commercial use in food, pharmaceutics, cosmetics, and photographic application.[6,7]

The Muslim population share 23.4% of the total world population (1.6 billion), which has been reported by Jamaluddin et al.[8] The demand for halal food is on the rise.[9] Regarding the increase in demand of halal food, an issue is raised by many scholars and scientists that, gelatin derived from the pig skin[10] is using in almost every processed food products. However, Muslims do not approve gelatin derived from prohibited sources like porcine gelatin except the extreme situation where there is no other alternative.[11] In contrast to that, pork derived gelatin can be replace by using gelatin derived from halal sources. Such as fish,[12] cow,[13] chicken and turkey[14] derived gelatin.

In the recent past, a handsome amount of review articles has published.[5,15,16] However, based on our exploration capability, no comprehensive study is available to clarify between porcine, and it's alternative (Halal) derived gelatin. The need of this study is to shed light on the issue of Halal and Haram gelatin-based products consumption. Further, showcased its importance in improving antioxidant activities and also outline some methodology to detect porcine adulteration and market data of major Islamic countries. This review might be helpful in the future regarding knowledge and significance about porcine, and its Halal alternative derived gelatin.

Sources of gelatin

The primary source of gelatin is pigskin, but some other sources are also contributing to fulfill requirements of gelatin production.[10,17] Porcine content is 46% to the total production of gelatin, bovine hide (29.4%) pork, and cattle bones (23.1%).[18] Therefore, more attention has been given to the alternatives of porcine gelatin.[19] Further talking about porcine-derived gelatin alternatives, the fish gelatin market share is still low comparing to bovine and porcine gelatin.[20] But there is a sizeable amount of available scientific studies reported that aquatic source derived gelatin exhibit better film-forming properties than that of mammalians.[21] In addition to that, fish gelatin with a low melting point was reported for having good release properties of food sensory attributes.[22] Therefore, it became an important issue to provide gelatin derived from *Halal* Sources. In contrast to which, gelatin derived from poultry, animals (considered as *Halal* and *slaughter according to Islamic rules)* and especially marine sources[23] can be accepted as *Halal* and might be a potential alternative for porcine gelatin (Table 1).

Table 1 Different raw sources of commercially produced gelatin

Source	Gel Strength (g)	References
Aquatic		
Farmed giant catfish (*Pangasianodon gigas*) skins	153	24
Mrigal (*Cirrhinus mrigala*) skins	343	25
Silver carp (*Hypophthalmichthys molitrix*) skins	600	10
Catla (*Catla catla*) swim bladders	265	26

Table Continued....

Source	Gel Strength (g)	References
Nile perch (*Lates niloticus*) skins	240	27
Rainbow trout (*Onchorhynchus mykiss*) skins	459	2)
Alaska pollock skins	98	28
Dover sole (*solea vulgaris*)	350	29
Seabass (*Lates calcarifer*)	321	30
Grey trigger fish	190	31
catfish (*Pangasius sutchi*) bone	254	12
Pink perch (*Nemipterus japonicas*) skins	140	32
Pink perch (*Nemipterus japonicas*) bones	130	32
Mammals		
Bovine skin	225	33
Pork skin	372	34
Cattle short tendons	350-410	35,36
Goatskin	226	37
Yak skin	NA	38
Poultry		
Chicken shank and toes	148	39
Skins and tendons of chicken feet	294	40
Chicken and turkey heads	332-368	14
Peking Duck	218	41

Commercial uses of gelatin

The unique gelling, stabilizing, healing, ointment, capsule and coating properties of gelatin made it as the most widely used biodegradable compound in commercial food production, pharmaceutical and photographic industries.[42–46] The clear and transparent structure of gelatin accounts for its significance, especially in the food and pharmaceutical industries.[42] Further, it has been reported that, annually, tons of gelatin has been used in candies, desert, meat, ice cream and bakery products.[42,47] Moreover, the gelatin also inhibits the recrystallization of lactose sugar during cold storage.[48] While in the pharmaceutical industry, the making of hard and soft capsule shells, tablets, granulation and syrups, all requires gelatin because it serves as a natural coating material and is also highly digestible. According to a report, pharmaceutical industry is using approximately 6% of the total gelatin production.[49] For the sports industry, gelatin plays an important role in energy drinks production for athletes and is a necessary component of energy drink.[50] In photography, first it was used in 1871 after coating the sensitizing agent on a glass plate in gelatin. The use of gelatin in the cosmetic industry is of high importance, as it is commonly using in shampoo, lipstick, conditioner, cream and fingernail formulas (link available in the reference section). Furthermore, gelatin derived from aquatic sources may be more applicable in the halal/kosher market than that of mammalian and porcine gelatin.

Antioxidant properties of gelatin derived from Halal and porcine sources

The increase in the production of biodegradable polymer like gelatin getting worldwide attention, one of the reasons why producer finds it as an attractive option is due to its antioxidant properties.[51,52] There are many sources of gelatin, however, there is a notable growing interest in producing gelatin from fish waste because of the outbreak of mad cow disease and the unacceptability of bovine and porcine-derived gelatin by Muslims, Jews and Hindus community.[53] Additionally, fish gelatin possess biologically active peptide, and such peptides have the potential to act as an antioxidant against the like of linoleic acid.[54,55] Further, the fish gelatin hydrolyzes with papain to produce antioxidant peptides, which exhibit high radical scavenging properties.[56] In contrast to that, hydrolysate derived from fish gelatin can be used as a functional food material that induces immunity against ultraviolet A in the skin and also protects food and others biological system from oxidation.[17,57] Moreover, the gelatin derived from the Pacific cod skin was hydrolyzed with pepsin and produced two bioactive peptides namely GASSGMPG (662 Da) and LAYA (436 Da),[58] it shows the strong inhibitory effect of Angiotensin-I-converting enzyme (ACE), an important enzyme in the control of hypertension and type-2 diabetes.[58] Further, they suggested using it in functional food preparation to lower the blood pressure and cardiovascular diseases (CVD).[59] In another study, gelatin from cuttlefish is reported for stopping the β-carotene bleaching by donating an atom to peroxyl radicals of linoleic acid. Which further demonstrated its importance in protecting food from drying and exposure to light.[58] Meanwhile, gelatin derived from the poultry waste also exhibit metal chelating and radical scavenging properties and can be considered as a *Halal* alternative of porcine gelatin.[60] Some other valuable peptides are also reported for its beneficial activity by many researchers confirmed the broad and wide range of available and functional peptides from porcine alternative source.[54,55,61,62] Thereby, according to Jridi et al.[59] all gelatins in all probability contained peptides which are electron or hydrogen donors that converts the free radical to the more stable product by reacting with them and dismiss the radical chain reaction.[59]

However, we will suggest after studying the recent research that fish gelatin (advantage of having odorless properties) has the edge over poultry gelatin due to the complication in managing poultry wastes.[63] Therefore fish gelatin can be utilized as a substitute antioxidant driver for porcine and bovine-derived gelatin.

Techniques regarding detection of porcine adulteration

In recent times, about 50,000 tons of beef meat has been found adulterated with horse meat in Europe,[64] and it cannot be an accident but a fraudulent act to mix the meat of different species such as horse or pork and blend it into the cattle beef, which creates concerns in the mind of ethnical groups (Muslims and Jews).[65] As the 1.5 billion Muslims shares around 20% of the world population and for them, the use of porcine-derived food products is strictly prohibited according to the teaching of Islam.[65,66] Such is the case with the production of gelatin as well. According to a report, about 80% of gelatin produced from the pigskin in Europe.[10] In addition to that, most of the food manufacturers use porcine-derived gelatin rather than its alternatives.[63,67] Due to the vast use of porcine gelatin, it is necessary for the Muslims to test the processed food for the detection of porcine-derived gelatin adulteration.[68] Because for the Muslim, the tolerance level becomes 0% when it comes to porcine and porcine-derived gelatin contamination in processed food.[65] Therefore we tabulated some of the advanced techniques regarding the detection of porcine gelatin in food products, from the previously published research articles (Table 2).

Table 2 Various techniques for screening porcine adulterated produces at molecular level

Techniques	Subjected product	References
RT-PCR (primer D-Loop 108)	Capsule shell	69
RT-PCR (using porcine specific primers)	Processed food products	70
Species-specific duplex polymerase chain reaction (PCR)	Gelatin capsules	71
Multiple reaction monitoring (MRM)	Halal beef	65
Surface Plasmon resonance (SPR)	Gelatin	72
Species-specific PCR using mitochondrial DNA	Gelatin	66
Species-specific coupled with whole-genome amplification	Gelatin capsules	73
Conventional and real-time PCR	Edible gelatin	74

Opportunity for industrial and market boost

The contribution from the waste of livestock, fisheries and poultry industry is important for a country GDP growth.[63] The main reason is that animal byproducts have the capability of decreasing the level of protein malnutrition and food insecurity.[75] According to the available online data, Muslim countries produce heaves of animal waste and do have the potential of producing a large amount of Halal gelatin (Table 3).[76–79] However, the exported values (Table 3) showing huge gap between the production of gelatin and the other variables (Meat and fisheries). This showcasing the poor management of animal by products in all the major Islamic countries. The reason might be lack of production facility and less knowledge about managing animal waste products. Therefore more attention is needed particularly in the area of managing waste from farm animals, aquatic sources and the poultry industry. As it is contributing in the local market economy, decrease concerns regarding the use of Halal and Haram gelatin and also increase the country economy by reducing the percentage of imported gelatin.

Table 3 Meat, Fish and gelatin production capacity of major Islamic countries

Countries	Exported value of (US Dollar Thousand)		
	Meat (offal)	Fisheries	Gelatin
Pakistan	239,741	336,380	5,639
Malaysia	49,135	516,249	227
Iran (Islamic Republic)	30,861	168,352	0
Turkey	370,847	744,561	21,531
Indonesia	20,715	2,900,604	113
Israel	1,349	13,685	128
Tunisia	2,129	126,159	374
United Arab Emirates	53,463	123,412	233
Qatar	2,514	1,253	0
Bangladesh	987	No data	1,194
Lebanon	968	672	0
Oman	91,864	162,864	1
Jordan	45,258	745	192

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Conclusion

The need for this review is to highlight the issue regarding Halal and Haram gelatin. As the major gelatin producing source in the international market is pigskin but it is always controversial for ethnical groups, such as Muslims and Jews. Therefore we summarized different porcine alternative gelatin sources, which provide better gelling, antioxidant and functional properties than that of porcine-derived gelatin. In addition to that, we tabulated some market data of major Islamic countries, which suggests that all those stated countries can produce a handsome amount of Halal gelatin and can make themselves gelatin sufficient. However, apart from Turkey, all other countries are producing gelatin less than their average requirement. The reasons must be varied such as the lack of waste management practices and industrial technology. Therefore, more work is required in the sector of waste management and adapt the state of art industrial technology to produce Halal gelatin inside the country.

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Conflicts of interest

Author declares that there is none of the conflicts.

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