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 used 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

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. It is the main protein connective tissue and widely found in mammals, birds and fishes. 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). Other functional properties of gelatin are of foaming, emulsifying, setting index and water holding capacity. Gelatin has commercial use in food, pharmaceutics, cosmetics, and photographic application. Gelatin is a sizeable amount of available scientific studies reported that aquatic and especially marine sources

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 mirgala) skins         | 343              | 25         |
| Silver carp (Hypophthalmichthys molitrix) skins | 600              | 10         |
| Catla (Catla catla) swim bladders      | 265              | 26         |

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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.\textsuperscript{62-66} The clear and transparent structure of gelatin accounts for its significance, especially in the food and pharmaceutical industries.\textsuperscript{32} Further, it has been reported that, annually, tons of gelatin has been used in candies, desert, meat, ice cream and bakery products.\textsuperscript{55,67} Moreover, the gelatin also inhibits the recrystallization of lactose sugar during cold storage.\textsuperscript{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.\textsuperscript{49} For the sports industry, gelatin plays an important role in energy drinks production for athletes and is a necessary component of energy drink.\textsuperscript{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

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 Hindu community.\textsuperscript{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.\textsuperscript{54,55} Further, the fish gelatin hydrolyzes with papain to produce antioxidant peptides, which exhibit high radical scavenging properties.\textsuperscript{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.\textsuperscript{12,57} 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),\textsuperscript{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.\textsuperscript{59} Further, they suggested using it in functional food preparation to lower the blood pressure and cardiovascular diseases (CVD).\textsuperscript{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.\textsuperscript{59} 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.\textsuperscript{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.\textsuperscript{54,55,56,62} Thereby, according to Jridi et al.\textsuperscript{30} 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.\textsuperscript{30}
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. 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, 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 ethnic groups (Muslims and Jews). 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. 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. In addition to that, most of the food manufacturers use porcine-derived gelatin rather than its alternatives. 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. Because for the Muslim, the tolerance level becomes 0% when it comes to porcine and porcine-derived gelatin contamination in processed food. 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. The main reason is that animal byproducts have the capability of decreasing the level of protein malnutrition and food insecurity. 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). 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 ethnic 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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