

A Biological Examination of the Process for Eliminating Contaminants from Halal Meat in Quranic Verses and Narrations

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Abstract

A shared concern of Islam and the life sciences is preserving community health, including individual nutrition. One type of nourishment is meat, and how it should be consumed to maintain human health. Therefore, this research seeks to answer the question: What solutions have the Quran and the Ahl al-Bayt (AS), as models of Islam, introduced for eliminating contaminants from Halal meat? In answer to this question, it must be said that Islamic teachings provide useful and effective strategies for the nutritional health of individuals, emphatically prescribing the consumption of Halal meat and outlining its proper hunting, slaughter, washing, cooking, and consumption. They also instruct on how contaminants such as worms and parasites in meat are eliminated. This study attempted, through interdisciplinary research in Islamic history and biology, utilizing library and laboratory science methods, to identify this biological process in Halal meat from the perspective of the Quran and the Ahl al-Bayt (AS). The research result showed that all these contaminants, which lead to zoonotic diseases (diseases shared between humans and animals), can be eliminated through these strategies and are demonstrable through life sciences.

Keywords: : Verses, narrations, halal meat, halal slaughter, zoonoses, cooking meat.

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Introduction

Among the concerns of Islam and the life sciences is attention to healthy nutrition and the preservation of community food safety. Therefore, verses and narrations contain abundant recommendations regarding hygiene and carefulness about food. These include advice to consume certain foods, prohibitions against eating others, and guidance on how to consume various types of food. For instance, from Imam al-Rida (peace be upon him), there exists a book named *Al-Risalah al-Dhabhiyyah* or *The Medicine of Imam al-Rida (as)*, in which such medical, nutritional, and hygienic recommendations are evident.

One type of food is meat, for which Islam recommends consuming its Halal (lawful) type. The very permissibility (halal) is the first step in eliminating a portion of meat contaminants. In the statements of the Ahl al-Bayt (peace be upon them), profound points are mentioned regarding the precise and correct consumption of meat and the adverse effects of its incorrect consumption. They have even pointed to meatborne contaminants, including stomach parasites or worms, and how to eliminate them. Consequently, this research seeks to answer the question: What measures have the Quran and the Ahl al-Bayt recommended for eliminating meat contaminants, and are these recommendations justifiable in light of modern sciences?

To answer this question, using library research and laboratory sciences, the process of preparing, slaughtering, hunting, and cooking Halal meat and the removal of its contaminants from the perspective of verses and narrations were examined. Subsequently, various types of meat contamination and the biological impact of Islam's strategies in removing these parasites were explained to demonstrate their effectiveness. The answer was formulated as follows: The teachings of the Quran and the Ahl al-Bayt (as) emphasize the consumption of Halal meat and provide useful and effective strategies for the health of individuals' nutrition, covering how to hunt, slaughter, wash, cook, and consume it, and how contaminants such as worms and parasites are eliminated.

To validate these strategies, the topic has been examined through the lens of modern science. Today, the connection between hadiths and life sciences in the scientific explanation of medical hadiths has deepened, as these investigations appear more precise under the scrutiny of laboratory sciences and contemporary technology. If the authenticity of the verses and narrations is confirmed, one can utilize medical hadiths and the doctrine of Islamic life sciences to accelerate the advancement of the life sciences.

Recommendations concerning the correct process of meat preparation, Halal meat, correct slaughter, and proper cooking are among the subjects expressed in other sources of the Islamic faith, including verses and narrations, without the

slightest contradiction, which corroborates their statements. The Quran and the Ahl al-Bayt have provided various recommendations for each stage: selecting suitable meat from among different types of Halal animals, the correct method of slaughter, separating harmful organs from the meat, washing it, and processes that alter the meat's nature. All these together rectify the process of preparing meat for human consumption into healthy and beneficial meat, which the life sciences also affirm, presenting the viewpoints of life sciences within Islam.

Research has been conducted in this field. This includes articles with a biological-microbiological approach investigating the impact of Halal slaughter on reducing meat contamination. For example, the article "Microbiological Quality of Halal Meat: A Review of Physiological Effects and Islamic Slaughter" by Khalid et al. (2023), which examines the effect of Halal slaughter on reducing microbial contamination and increasing meat shelf-life from a biological perspective—meaning it only addresses the issue of Halal slaughter and does not consider other processes for eliminating meat contaminants (Khalid, T., Aïder, M., & Han, J. (2023). 148, 109674).

Another article titled "Biological Mechanisms of Blood Removal in Halal Slaughter and Its Impact on Bacterial Growth in Meat" by Hassan and Farouk (2022) is an experimental study examining the mechanism of blood drainage in religious slaughter and its relationship to inhibiting bacterial growth (Hassan, M. A., & Farouk, M. M. (2022). 64(5), 1012–1024). Other articles in this vein exist, but due to their repetitive nature, they are not discussed here.

In part of the book *The Science of Halal Food: From Islamic Sharia to Modern Biotechnology*, Chapter 5 specifically addresses the biological analysis of meat purification in Halal slaughter. This book was written in Singapore in 2023, but like the other mentioned studies, it only deals with Halal slaughter and does not cover the process of eliminating meat contaminants from animal selection to cooking (Al-Mazeedi, H. M., & Regenstein, J. M. (2023)).

Another book is by Farouk, containing chapters on the impact of Halal slaughter on tissue deoxygenation and the reduction of pathogen growth conditions. Titled *Halal and Sustainable Meat Production: Scientific Advances and Global Perspectives*, it was published in the USA in 2021 (Farouk, M. M. (Ed.). (2021)).

Another work, in line with the previous materials, titled "Technical Review: Biological Basis of Hygiene in Halal Slaughter," was published by the Islamic Food and Nutrition Council of America (IFANCA) in 2022. It refers to microbiological evidence of the benefits of Halal slaughter (Islamic Food and Nutrition Council of America (IFANCA). (2022)).

Given that the present research considers the entire process from preparation to consumption of meat, focusing on Halal meat and specified animals, this research represents a new initiative in the realm of novel interdisciplinary studies and can be beneficial for interested parties.

A. Recommendation for Proper Meat Consumption

In Islam, consuming meat is recommended due to its many benefits. Imam Ali (peace be upon him) said: "Meat and fat were mentioned in the presence of the Prophet (peace be upon him and his family). He said: 'No morsel of these two settles in the stomach except that healing sprouts in its place and an ailment departs from there'" (Ibn Babawayh, 1373 AH, Vol. 2, p. 41). Imam al-Rida (peace be upon him) said: "Whoever fears a migraine or stomach ache should not delay eating fresh fish in summer or winter" (Al-Majlisi, 1403 AH, Vol. 62, p. 324).

Islam recommends eating meat without excess or negligence. The Prophet of God (peace be upon him and his family) said: "Whoever goes forty days without eating meat becomes ill-tempered. Eat meat, for it enhances your hearing" (Al-Daylami, 1406 AH, Vol. 3, p. 627). He also said: "You should eat meat, for meat makes the human body grow. Whoever spends forty mornings without eating meat becomes ill-tempered. Whoever becomes ill-tempered, feed him meat. Whoever eats its fat, that fat will bring down illness upon him" (Al-Majlisi, 1403 AH, Vol. 66, pp. 56, 58, 67).

As for the moderate amount of meat consumption, it is reported that meat was mentioned in the presence of Imam al-Sadiq (peace be upon him). He said: "Eat meat one day, milk another day, and other food on the third day" (Al-Majlisi, 1403 AH, Vol. 66, p. 70).

For the consumption of certain types of meat, it is recommended to use a corrective food (Muslih). For example: Imam al-Rida (peace be upon him) said: "A small amount of Sawīq (a barley/wheat meal) digests sheep's head and trotters and is its remedy" (Al-'Aqīl, 1419 AH, p. 64 – Al-Majlisi, 1403 AH, Vol. 62, p. 321).

In the words of the verses and narrations, excessive consumption of meat is also prohibited. For example, Imam al-Rida (peace be upon him) said in another statement about regularly eating kidneys and tripe: "Habitual eating of sheep kidneys and their stomachs (tripe) inverts the bladder" (Al-'Aqīl, 1419 AH, p. 64; Al-Majlisi, 1403 AH, Vol. 62, p. 321).

Imam al-Sadiq (peace be upon him) said about this: "Three things break down the body and may kill: eating cured meat (Qadīd) is one of the three things" (Al-Majlisi, 1403 AH, Vol. 66, p. 64).

"In microbiology, it has been proven that microbes cannot thrive in plant materials the way they do in meat. The stomach and feces of no animal are as putrid as those of carnivorous humans. This foul odor emanating from human feces is

evidence of the putrefaction of meat materials in their intestines" (Al-Jazā'irī, 1344 AH, p. 47).

B. Selecting Good and Halal Meat

There are recommendations from the Ahl al-Bayt (peace be upon them) regarding how to choose meat. Sa'd ibn Sa'd said to Imam al-Rida (peace be upon him): "My family does not eat ewe meat." The Imam said: "It stirs up diseases and pains" (Behbudī, 1384 AH, Vol. 3, p. 189). Thus, in the Imam's hadith, there is a recommendation to eat meat for preserving health.

The Messenger of God (peace be upon him and his family), in a narration, introduced meat as the best food in the world, saying: "The master of food in this world and the Hereafter is meat and rice" (Al-Tabrasi, Makārim al-Akhlāq, 1365 AH, p. 178; Ibn Babawayh, 1373 AH, Vol. 2, p. 35). This points to the nutritional value of meat.

The meat consumed by humans in the world includes many types, but in Islam, this diversity is defined within the limits set by God, encompassing various kinds referred to as Halal animals. These include some animals, such as cloven-hoofed quadrupeds, non-predatory birds, and scaled fish. Halal animals are those whose parts, after proper slaughter (Tadhkiyah), are permissible to eat (Majhūl, 1387 AH, Vol. 2, p. 426).

The method the Quran points to in selecting meat is as follows: "So eat of what Allah has provided for you [which is] lawful and good. And be grateful for the favor of Allah, if it is [indeed] Him that you worship" (Surah An-Nahl, 16:114).

In verses from Surah Al-An'am, God explicitly names these animals: "And of the grazing livestock are carriers [of burdens] and those [too] small. Eat of what Allah has provided for you and do not follow the footsteps of Satan. Indeed, he is to you a clear enemy. [You will have] eight mates: of the sheep, two and of the goats, two. Say, 'Is it the two males He has forbidden or the two females or that which the wombs of the two females contain? Inform me with knowledge, if you are truthful.' And of the camels, two and of the cattle, two. Say, 'Is it the two males He has forbidden or the two females or that which the wombs of the two females contain? Or were you witnesses when Allah charged you with this? Then who is more unjust than one who invents a lie about Allah to mislead the people by [something] other than knowledge? Indeed, Allah does not guide the wrongdoing people'" (Surah Al-An'am, 6:142-144).

Other principles are also considered in how to select meat, as mentioned in Surah Al-Baqarah:

"He has only forbidden to you dead animals, blood, the flesh of swine, and that which has been dedicated to other than Allah. But whoever is forced [by neces-

sity], neither desiring [it] nor transgressing [its limit] - then indeed, Allah is Forgiving and Merciful" (Surah Al-Baqarah, 2:172). In Surah Al-Ma'idah, it is stated: "O you who have believed, fulfill [all] contracts. Lawful for you are the animals of grazing livestock except what is recited to you [in this Qur'an]" (Surah Al-Ma'idah, 5:1).

Halal meat has a connection with spiritual purity. The Prophet (peace be upon him and his family) said: "Whoever's sustenance is *halal*, his heart becomes pure and tender, his eyes tearful from the fear of God, and his supplication is answered" (Al-Tabrasi, *Majma' al-Bayān*, 1359 AH, Vol. 5, p. 353). The Holy Quran says: "O messengers, eat from the good foods and work righteousness..." (Surah Al-Mu'minun, 23:51).

C. Halal Hunting

The importance of selecting, hunting, and slaughtering meat in Islam is so significant that specific rulings have been issued for its various processes. The method of the Ahl al-Bayt (peace be upon them) in hunting and slaughtering Halal animals is a method explicitly mentioned in the Quran. For instance, Surah Al-Ma'idah specifies good hunting practices:

"Prohibited to you are dead animals, blood, the flesh of swine, and that which has been dedicated to other than Allah, and [those animals] killed by strangling or by a violent blow or by a head-long fall or by the goring of horns, and those from which a wild animal has eaten, except what you [are able to] slaughter [before its death], and those which are sacrificed on stone altars, and [prohibited is] that you seek decision through divining arrows. That is grave disobedience..." (Surah Al-Ma'idah, 5:3).

"They ask you, [O Muhammad], what has been made lawful for them. Say, 'Lawful for you are [all] good foods and [game caught by] what you have trained of hunting animals which you train as Allah has taught you. So eat of what they catch for you, and mention the name of Allah upon it, and fear Allah.' Indeed, Allah is swift in account" (Surah Al-Ma'idah, 5:4).

D. Halal Slaughter (Tadhkiyah)

There are also recommendations regarding how to consume the meat of these *halal* animals, such as *halal* slaughter, where all blood must be allowed to drain from the animal's body at the time of slaughter, preventing suffocation and blood retention. The etiquettes, recommended acts, and disliked acts that exist in Islamic jurisprudence regarding animal slaughter indicate the necessity of observing animal rights.

Instructions such as the sharpness of the slaughtering tool, the prohibition of severing, cutting, or mutilating a limb of the animal while alive, and the appropriateness of the hunting tool to the prey are evident. Among these is that slaughter

must be performed with a sharp iron tool and with force so that the act is carried out quickly, resulting in less suffering for the animal. Furthermore, rotating the knife (during the cut) is considered disliked due to the extra distress it causes the animal (Tabatabai, 1388 AH, p. 83).

It is recommended to give the animal water before slaughter. This aspect, besides its psychological benefit, is also hygienically important for reducing the microbial load in the intestines. Additionally, the intended animal should have eaten, be alive and healthy, and be slaughtered in the name of God solely for food and not for any other reason. Furthermore, the animal should be slaughtered with a sharp object like a knife in a swift manner, with minimal pain, and by cutting only a few veins (the throat, windpipe, and esophagus). The blood must also be completely drained to prevent the formation of a suitable environment for micro-organism growth. The spinal cord should not be severed, as cutting it may damage the nerve fibers connected to the heart during the process, causing cardiac arrest. Consequently, blood may stagnate in the vessels and not be fully drained (Khezlloo, Arezoo, et al., 1399 AH, pp. 79-80).

Furthermore, complete exsanguination improves the quality and shelf life of the meat (Carrasco-García AA, et al., 2020; 33(10):1656-65). If an animal is slaughtered under stress, its glycogen stores will be depleted in response to stress, resulting in a higher ultimate pH in the meat from such animals (Carrasco-García AA, et al., 2020; 33(10):1656-65).

Lipid oxidation is one of the most important non-microbial factors in meat deterioration under storage and cooking conditions, which cannot be controlled even through refrigeration or freezing (Alvarado C. & others, 2007; 86(1):156-61).

Considering these findings, it can be concluded that *halal* slaughter guarantees meat quality and shelf life according to consumer needs and also supports the interests of the meat industry (Soyer A, & others, 2010; 120(4):1025-30).

In a study by Ibrahim and colleagues in 2014, the effect of Halal and non-Halal slaughter on the microbial load of chicken meat was investigated. The results showed that the microbial load in Halal chicken meat was lower compared to non-halal. Results from examining the microbiological characteristics of burgers made from Halal and non-Halal chicken meat showed that the total count of viable microorganisms in the Halal burger was lower than in the non-Halal meat burger. On the other hand, the total count of mold and yeast was higher in the Halal meat burger compared to the non-Halal one (Ibrahim SM, & others, 2014; 4(5):223-8).

Moreover, in burgers made from Halal meat, coliforms, *E. coli*, and *Salmonella* were not detected. Blood is a suitable medium for bacteria and toxins. Therefore, the Muslim method of slaughter is more hygienic because a significant amount of

blood containing pathogens such as microbes and toxins is removed (Ibrahim SM, & others, 2014; 4:113-7).

Meat slaughtered according to the Islamic method, due to its lower blood content compared to other slaughter methods, will remain fresh and healthy for a longer period (Awan JA, Sohaib M. 2016; 26: 234-40).

In summary, the Halal slaughter method involves a horizontal cut severing the four vessels of the throat (the two carotid arteries, the trachea, and the esophagus) without using any type of anesthesia before slaughter. After slaughter, a large amount of blood is drained. Complete exsanguination during slaughter leads to better quality, longer shelf life, and reduced defects in the meat and carcass (Khezlloo and colleagues, 1399 AH, pp. 79-87). In Halal slaughter, a significant amount of blood leaves the animal's body. This is not only because consuming blood is prohibited in Islam, but incomplete exsanguination also negatively affects meat quality. Therefore, complete exsanguination improves meat quality and shelf life. Considering that blood is a natural medium for the growth of most microorganisms, the presence of blood in meat due to incorrect and incomplete bleeding leads to the growth and proliferation of spoilage-causing bacteria (Fuseini et al., 2016). Residual blood in meat increases the retention of hemoglobin, which is considered a powerful promoter of lipid oxidation. Lipid oxidation is one of the most important non-microbial factors in meat deterioration under storage and cooking conditions, which cannot be controlled even through refrigeration or freezing (Alvarado et al., 2007).

One of the most important factors affecting changes in meat quality is the amount of blood remaining in the veins and capillaries, which increases the perishability of meat (Ali et al., 2011; Nakyinsige et al., 2014). Blood, as long as it contains nutrients, will be a suitable environment for bacterial growth. In Halal slaughter, the cut is made in the neck area (Gregory et al., 2012), where most neck vessels are severed, and rapid bleeding leads to more blood exiting from the head and neck. Meat with less blood lacks some nutrients, yet by reducing product spoilage, it increases the product's shelf life.

E. Separating Forbidden Organs and Parts (Completion of Tadhkiyah)

The method of Tadhkiyah (ritual purification/slaughter) varies for different animals, including slaughter (Dhabh), slaughtering by incision at the neck (Nahr), hunting, and catching fish, each with its own etiquettes. For example, Dhabh and Nahr must be performed by a Muslim using specific tools and according to religious etiquettes. After Halal slaughter, certain organs such as lymph nodes, the spleen, etc., whose consumption is forbidden, must be separated from the meat. The entirety of these actions is called Tadhkiyah (Al-Naraqi, 1415 AH, Vol. 15, p. 328). This involves completing all the stages and conditions of slaughter, which

further contributes to the healthiness of the meat. The term is used in verse 3 of Surah Al-Ma'idah, which declares the consumption of meat from animals not properly purified (Tadhkiyah) as forbidden (Al-Ma'idah, 5:3).

F. Washing the Meat

Afterward, the meat must be washed and then prepared for consumption by changing its state through heat. Just as cooking has been the primary method of preparing meat-based foods and no recommendation for eating it raw is seen—this was the practice of the divine prophets—so too was washing it part of the practice (Sunnah) of the prophets and in the conduct and statements of the Prophet of Islam and the Ahl al-Bayt (peace be upon them).

The Prophet of God (peace be upon him and his family) said: "My brother Jesus passed by a town and saw that its people had yellow faces and dark circles under their eyes. They complained to him about the illnesses they had. He said: 'Your cure is with you. When you eat meat, you cook it unwashed, while nothing leaves this world without a kind of impurity (Janabah).' From then on, they washed their meat before consumption, and consequently, their illnesses disappeared." (Al-Rawandi, 1430 AH, p. 274 – Al-Majlisi, 1403 AH, Vol. 14, p. 321 & Vol. 62, p. 161).

G. Prohibition of Consuming Raw Meat

In Islam, consuming raw meat is prohibited. There are various narrations forbidding the consumption of raw meat.

Imam al-Baqir (peace be upon him) said: "The Prophet of God prohibited meat from being eaten raw and said: 'Only beasts of prey eat such meat. Eat meat when the sun or fire has altered it.'" (Al-Kulayni, 1411 AH, Vol. 6, p. 313). The Prophet of God (peace be upon him and his family) also forbade meat from being eaten raw and said: "Only beasts of prey eat such meat. Eat (meat) when the sun or fire has altered it." (Al-Kulayni, 1411 AH, Vol. 6, p. 313). Imam al-Sadiq (peace be upon him) was also asked about eating raw meat; he said: "This is the food of beasts of prey." (Al-Kulayni, 1411 AH, Vol. 6, p. 314).

Furthermore, a narration from Imam al-Rida (peace be upon him) strictly prohibits consuming raw meat and addresses a new dimension of diseases associated with raw meat, which are zoonotic and transmissible to humans. He said: "Eating raw meat produces worms in the stomach." (Al-'Aqil, 1419 AH, p. 28). By referring to parasites in raw meat, he points to the method of eliminating these parasites through heat and thorough cooking.

H. Cooking and Transforming the Nature of Meat

Two forms of transforming the nature of meat are defined: one is cooking, and the other is salting and drying in sunlight. Disadvantages have been mentioned for the latter method. Therefore, the best available method for altering the state

of meat is cooking. Many advantages are cited for it, but excessive consumption is cautioned against due to its specific psychological and spiritual side effects.

The Prophet of God (peace be upon him and his family) said: "Noah complained to his Lord about bodily weakness. God sent him revelation: 'Cook and eat meat with milk, for I have placed strength and blessing in them.'" (Al-Daryayi, 1388 AH, p. 64).

Among the various methods of transforming meat, the best is cooking it thoroughly, and the disadvantages of other methods are mentioned. In various narrations, people are prohibited from eating aged/cured meat and relish meat (Hush al-lahm):

Imam al-Sadiq (peace be upon him) said: "Four things age (a person) before the arrival of old age: eating dried meat..." (Al-Harrani, 1423 AH, p. 317). He also said: "Three things wear out the body and may even kill: eating spoiled dried meat, bathing on a full stomach, and..." (Al-Kulayni, 1411 AH, Vol. 6, p. 314). Elsewhere, he said: "Three types of food cause thinness: dried meat, cheese, and date blossoms." (Al-Kulayni, 1411 AH, Vol. 6, p. 315). And he also said: "Two things are harmful in every respect and beneficial for nothing...: dried meat and cheese." (Al-Kulayni, 1411 AH, Vol. 6, p. 315).

Imam al-Hadi (peace be upon him) said: "Salted dried meat is a bad thing; for it becomes soft in the stomach, stirs up every illness, and is not beneficial for anything; rather, it is harmful." (Al-Kulayni, 1411 AH, Vol. 6, p. 314). He also said: "I have not eaten any food heavier and more disease-causing than dried meat." (Al-Kulayni, 1411 AH, Vol. 6, p. 314).

All these recommendations are expressed in emphasis of one another, meaning this was the method of the Ahl al-Bayt (peace be upon them). Therefore, the best method for cooking and transforming the nature of meat is cooking it thoroughly.

Contaminants Transmissible from Undercooked Halal Meat to Humans and the Impact of Cooking on Them

Numerous pathogens can be transmitted to humans through contaminated meat. Some of these agents are transmitted via the meat itself, while others result from contamination with gut contents that does not remove through ordinary washing and is transmitted by consuming raw or undercooked meat. Below are some of the most important diseases transmitted through consuming raw or undercooked meat.

1. Beef Tapeworm (*Taenia saginata*)

A zoonotic parasite (Torgerson, 2013) causing taeniasis in humans and cysticercosis in cattle, the latter being a significant concern for the global beef indus-

try. Many countries in East, Southeast, and South Asia are experiencing rapid economic growth, with an increasing number of people dependent on the livestock industry.

Bovine cysticercosis is the infection of cattle with the metacestode stage of the tapeworm *Taenia saginata* (Ogunremi et al., 2004).

The definitive host (human) becomes infected with *T. saginata* by consuming viable cysticerci in raw or undercooked beef. In the intestine, the adult worm reaches 4 to 12 meters in length, and individuals may remain infected for several years. Approximately 6 to 9 gravid proglottids, each containing 50,000 to 80,000 eggs, are shed daily either during defecation or through active migration (Dorny et al., 2007). Up to 720,000 *T. saginata* eggs can be released into the environment daily by one infected human (Cabaret et al., 2002).

After cattle (the intermediate hosts) ingest eggs through contaminated feed, forage, or water, the oncosphere penetrates the intestinal wall to reach skeletal and cardiac muscles and other tissues, where it develops into a cysticercus (BCC) and becomes infectious to humans within about 10 weeks (Dorny et al., 2007). Cysticerci in striated muscles begin to degenerate and calcify within months post-infection, and after 9 months, the number of viable cysticerci decreases significantly (Allan et al., 2005).

Source of Transmission: Beef infected with cysticercosis.

Symptoms: Symptoms may include mild abdominal discomfort, nausea, mild diarrhea, weight loss, and anal itching, although serious gastrointestinal disturbances such as intestinal obstruction or perforation and peritonitis have been reported (Jongwutiwes, 2004; Craig, 2007; Mendlovic et al., 2020).

2. Toxoplasmosis (*Toxoplasma gondii*)

Toxoplasmosis is a globally distributed zoonotic disease caused by the protozoan parasite *Toxoplasma gondii*, the only species in the genus *Toxoplasma*. *T. gondii* can infect almost any warm-blooded animal, including humans and livestock, as intermediate hosts (IH) (Dubey, 2020).

T. gondii is considered one of the most important food and waterborne parasites with veterinary and medical significance.

Source of Transmission: The primary route is through ingesting tissue cysts in raw or undercooked meat from infected animals.

Symptoms: *T. gondii* is a public health concern, especially for immunocompromised individuals and pregnant women. While healthy adults are generally asymptomatic, severe, even fatal, clinical disease is seen primarily in neonates and immunodeficient individuals (e.g., HIV infection, long-term corticosteroid therapy, hematologic malignancies, and transplant recipients). In women, primary infections during pregnancy can lead to spontaneous abortion, fetal death,

and stillbirth (Cong et al., 2015). Studies suggest *T. gondii* can alter human behavior (Martinez et al., 2018). Another important clinical manifestation is ocular toxoplasmosis, with prevalence among infected individuals estimated at about 2% in Europe and 17% in South America (Almeria et al., 2021).

3. Sarcocystosis (*Sarcocystis* spp.)

Sarcocystosis is caused by an intracellular apicomplexan protozoan parasite with a global distribution. Carnivores and humans serve as definitive hosts, while herbivores including cattle, sheep, goats, poultry, and pigs are intermediate hosts (Dubey et al., 1989). This parasite forms tissue cysts in its intermediate hosts. Over 200 species are known, but only a few threaten human health due to infections in livestock species.

Symptoms: These infections may cause mild enteritis but are often asymptomatic. Humans can also act as dead-end (intermediate) hosts for non-human *Sarcocystis* species. Accidental ingestion of sporocysts can lead to extra-intestinal sarcocystosis. In cases of infection with non-human sarcocysts, the clinical spectrum can range from asymptomatic muscular cysts to severe, acute eosinophilic myositis accompanied by systemic symptoms and peripheral eosinophilia (Rosenthal et al., 2021).

The protozoan parasite can cause symptoms such as anorexia, mild fever, vomiting, diarrhea, and respiratory problems in humans (Fayer, 2004).

Source of Transmission: Intestinal sarcocystosis occurs when individuals consume raw or undercooked meat or meat products contaminated with *Sarcocystis hominis* or *S. heydorni* (Dubey et al., 2015; Fayer et al., 2015; Rosenthal et al., 2012; Jafari et al., 2022).

4. Ascariasis (*Ascaris*)

Zoonotic *Ascaris* infections primarily involve two species of roundworms: *Ascaris lumbricoides*, pathogenic in humans, and *Ascaris suum*, typically found in pigs but can also infect cattle and occasionally humans. Highest prevalence is in children under 5 years.

Source of Transmission: *Ascaris lumbricoides* is one of the most common intestinal parasites in humans, causing ascariasis. The disease is more prevalent in areas with poor sanitation and is transmitted by ingesting the worm's eggs. Meat can become contaminated with parasite eggs during evisceration, and humans become infected by consuming undercooked meat.

Symptoms: Most patients with intestinal ascariasis are asymptomatic. For those with symptoms, anorexia, nausea, bloating, abdominal discomfort, recurrent abdominal pain, abdominal distension, and intermittent diarrhea are not uncommon. Other clinical manifestations vary greatly depending on underlying complications. Complications include Löffler's syndrome, intestinal obstruction,

biliary colic, recurrent pyogenic cholangitis, cholecystitis, obstructive jaundice, kidney stones, pancreatitis, and malnutrition. Patients infected with *A. lumbricoides* require anthelmintic treatment, even if asymptomatic, to prevent complications from parasite migration (Leung et al., 2020).

5. Giardiasis (*Giardia*)

Giardia intestinalis (also known as *G. lamblia* or *G. duodenalis*) is a non-invasive protozoan parasite that infects the upper small intestine, causing acute watery diarrhea or giardiasis in 280 million people annually.

Source of Transmission: As giardiasis is an intestinal infection, meat can become contaminated with this parasite during evisceration, creating serious problems.

Symptoms: Asymptomatic infections are equally common. However, infections can lead to chronic disease, and treatment failures are common worldwide. *Giardia* infection can also lead to post-infectious irritable bowel syndrome (IBS) and food allergies, causing post-giardiasis syndromes and treatment failures (Einarsson et al., 2016). This understanding is particularly important given the significant range of initial manifestations, varying from asymptomatic to persistent diarrhea and weight loss, and long-term consequences that include growth stunting in children who had no obvious symptoms and a high frequency of post-infectious IBS (Rodney, 2021).

6. Cryptosporidiosis (*Cryptosporidium*)

Cryptosporidium species are among the most important causes of diarrhea in humans. The most significant species causing human cryptosporidiosis are *C. hominis* and *C. parvum*. However, species like *C. meleagridis*, *C. felis*, and *C. canis* cause a very low incidence of human disease. Zoonotic species and genotypes, such as *C. parvum*, can have serious consequences for human and animal health (Kifleyohannes et al., 2022).

Cryptosporidium is considered a zoonotic fish-to-human hazard. Several *Cryptosporidium* species have been identified in freshwater, farmed, marine, and ornamental fish worldwide (Golomazou et al., 2021).

Although cryptosporidiosis is often overlooked in clinical examinations, it can cause fatal diarrhea, particularly in immunocompromised patients. Because the disease is not considered in clinical examinations, ineffective and prolonged treatments are tried. Consequently, unnecessary medication is applied to the patient, and due to the lack of appropriate drug therapy, the patient's condition worsens (Ekici et al., 2022).

Source of Transmission: *Cryptosporidium* is an intestinal infection; meat can become contaminated with this parasite during evisceration, and eating raw or undercooked meat or fish transmits the infection.

7. Diphyllbothriasis (*Diphyllbothrium*)

Humans are the definitive host in the *Diphyllbothrium* life cycle, harboring the adult stage in the intestine. Copepods (e.g., *Cyclops* sp.) are the first intermediate hosts. When fish, the second intermediate host, ingest infected copepods, procercoids develop into plerocercoid-type larvae in the muscles. When the definitive host, humans, consume raw or undercooked infected fish, the plerocercoid develops into an adult tapeworm in the intestine (Galán-Puchades, 2020).

Fishborne helminthic diseases may be associated with mild to severe allergic or gastrointestinal diseases such as indigestion, abdominal pain, and diarrhea, or may cause severe manifestations like cerebral hemorrhage and cancer (Hajipour et al., 2023).

8. Clonorchiasis (*Clonorchis sinensis*)

Clonorchis sinensis is a trematode known as the Chinese or oriental liver fluke. These liver flukes are common parasites of fish-eating mammals. Cats and dogs in endemic areas are the most common hosts, but *C. sinensis* can be transmitted to humans who eat infected fish. When a person becomes infected with *C. sinensis*, it can live in their biliary system for years, leading to various symptoms including cholecystitis, cholangitis, and cholangiocarcinoma (Locke et al., 2022). The aforementioned complications can lead to a range of disorders and carcinogenesis in the liver and biliary system (Xie et al., 2022).

Humans become infected by consuming fish meat containing metacercariae that is not properly cooked or is raw.

9. Anisakiasis (*Anisakis* spp.)

Anisakiasis is a disease caused by nematodes of the genus *Anisakis*, occurring in humans due to consumption of fish infected with larval stages. Humans can become accidental hosts by consuming raw, smoked, salted, or undercooked fish and squid (Mattiucci et al., 2018).

Symptoms: Onset in humans may occur within 4 hours of consuming fish, presenting as nausea and vomiting. In more severe cases, blood may appear in stool about 7 days after consuming infected fish. When larvae embed in the stomach, disease signs include nausea, vomiting, and abdominal pain very similar to peptic ulcer pain, occurring 1-2 hours after eating infected fish. Symptoms of anisakiasis include mild to severe abdominal pain, nausea, and diarrhea, and can also include severe allergic reactions. Reports of gastrointestinal infections accompanied by allergic reactions to *Anisakis* have increased. *Anisakis* allergy includes a large number of unexplained acute allergic episodes as well as chronic urticaria. Sneezing, coughing, tearing, diarrhea, and vomiting can also be observed in *Anisakis* allergy reactions. When the small intestine or colon is involved, pain in the lower abdomen is present, which may sometimes be mistaken for appendicitis. It

is thought that anisakiasis may predispose to stomach cancer. In some cases, larvae penetrate the intestinal wall into the abdominal cavity, eventually causing peritonitis (Aibinu et al., 2019; Speciale et al., 2017). Cases of ectopic anisakiasis are less common, involving larval migration to tissues such as the pharynx, tongue, lung, peritoneal cavity, lymph nodes, or pancreas.

The FDA recommends freezing at -20°C for 7 days or blast freezing at -35°C for 15 hours. Freezing time can depend on the thickness of the fish (Nieuwenhuizen, 2016). Avoiding consumption of raw or undercooked fish can prevent the disease (Aibinu et al., 2019; Speciale et al., 2017).

Conclusion

This research sought to biologically examine the process of eliminating contamination from Halal meat from the perspective of the Ahl al-Bayt (peace be upon them). Therefore, it does not encompass other non-Halal meats, as selecting Halal meat is the first step toward achieving meat safety. The recommendations of the Ahl al-Bayt were considered within a process involving the selection of Halal meat, Halal hunting and slaughter, washing, moderate consumption, the use of corrective foods (Muslih), and finally, cooking to eliminate worms and parasites in preventing meatborne zoonotic diseases.

To biologically investigate the subject, various aspects of these recommendations were examined using results from scientific laboratory studies, and a list of related diseases was reviewed. This demonstrates that thorough heating (cooking) destroys all of these contaminants. This indicates the effectiveness of the Islamic biological doctrine, which aligns with the criteria of modern life sciences and has for many years ensured the personal, social, psychological, and even biological health of people. It is a doctrine that has conveyed concepts in the simplest and most precise terms and has contributed to the rapid dissemination of this knowledge.

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