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The potential for foodborne disease stemming from the consumption of quail products: A systematic review

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Abstract

Background and Aim: Investigation of the zoonotic potential of quail-derived food items, including eggs and meat, and their consequential impact on the health of the general population is insufficient. The present study provides a comprehensive overview of the potential hazards associated with consuming quail eggs and meat products with a One Health approach based on the existing body of knowledge derived from multi-disciplinary studies.

Materials and Methods: A total of 37 studies from 2004 to 2021 were procured from four distinct databases following a two-stage screening process involving practical and methodological screening. The utilization of a descriptive qualitative method with a meta-aggregation approach was employed to scrutinize these studies, leading to a definitive conclusion regarding the risks of foodborne diseases associated with the consumption of quail meat products.

Results: A total of 7555 studies were retrieved and 146 were qualified based on the predetermined criteria. Of 146 studies, 90 studies were eliminated based on duplication screening. Of the 90, 37 were determined to be related to the aim of this research.

Conclusion: The consumption of quail eggs and meat products poses a significant risk for foodborne diseases, with potentially greater ramifications than currently recognized, particularly in the areas of food safety, public health, conservation, and the economy.

Keywords: foodborne disease, One Health, quail.

Introduction

Foodborne disease is a malady that arises from the consumption of contaminated food, and it has emerged as a significant public health concern, particularly in the domain of food safety [1]. Notably, the global incidence of foodborne diseases is estimated to be approximately 600 million cases annually, with a mortality rate of 420,000 [2]. Notably, diverse food sources encompassing animal products may be potential etiological agents for foodborne diseases [3].

The avian species *Coturnix coturnix*, commonly known as quail, holds significant economic and social importance in the food industry. However, it has inherent risks of foodborne disease [4]. The high nutritional value inherent in quail eggs and meat has led to their widespread consumption in various regions across the globe [5]. The acquisition of quail as a consumable commodity may be achieved through either hunting or cultivation. Cultivating Japanese quail, in particular, may present a viable solution to the issue of malnutrition in developing nations [6, 7]. The considerable potential of quail products as a food source necessitates the implementation of measures to avert any potential issues arising from their consumption. The fundamental measure for averting the incidence of foodborne diseases is to conduct a comprehensive inquiry into the potential hazards associated with consumption of quail-derived commodities. It is imperative to adopt a multi-disciplinary approach in light of the magnitude of the impact that is concomitant with this risk.

This study aimed to conduct a comprehensive analysis of the potential hazards associated with the consumption of eggs and quail meat to adopt a multi-disciplinary approach that considers the interplay of various factors, including but not limited to food safety, public health, conservation, and the economy. The ultimate objective was to arrive at a holistic understanding of the risks that may have a bearing on these domains.

Materials and Methods

Ethical approval

Ethical approval was not required for this study, because it was based on a literature review

Study period and location

Data were extracted and interpreted from November 2021 to June 2021 at Padjajaran University.

Search criteria

This systematic review followed PRISMA guidelines [8, 9]. We searched from 4 electronic search engines (Google Scholar, Pubmed, Sciencedirect and ResearchGate) for books, journals, articles, and reseacrh reports published between January 1, 2004, and October 31, 2021, with the keywords of foodborne disease by consumption of quail; foodborne disease by consumption of quail in Indonesia; one health aspect in risk of foodborne disease by consumption of quail; and risk of foodborne disease by quail hybridization.

Inclusion and exclusion criteria

The criteria for inclusion in the study are as follows: The pertinent literature, written in either English or Bahasa, pertaining to quail, foodborne diseases, and One Health concept has been thoroughly scrutinized. The complete texts of these papers are readily accessible and serve to bolster the objectives of this investigation. Meanwhile, the criteria for exclusion from the study are certain non-English and Bahasa literatures, which lack supportive findings for the study's aim and are inaccessible in their full-text versions.

The curation of pertinent literature consists of two distinct phases. The initial phase involved a practical screening of relevant literature, wherein we meticulously reviewed the titles, keywords, and abstracts of all papers pertaining to our search terms. Subsequently, the process of methodological screening ensues, whereby a comprehensive evaluation of the literature's full-text rendition is conducted based on predetermined criteria.

Statistical analysis

The process of charting and synthesizing data involves meticulous analysis and screening, which served to corroborate the objectives of this study. The data were classified according to the resemblance of their observations. Subsequently, every classification was meticulously analyzed to amalgamate novel discoveries that bolstered the objective of this investigation. The novel discoveries from each classification have been explicated to address the problem formulation of this investigation. The schematic figures were elaborated using www.biorender.com.

Results

A total of 7555 scholarly articles were procured from four electronic databases, namely, Google Scholar, PubMed, ScienceDirect, and ResearchGate, utilizing the following keywords: "foodborne disease by consumption of quail," "foodborne disease by consumption of quail in Indonesia," "One Health aspect in the risk of foodborne disease by consumption of quail," and "the risk of foodborne disease by quail hybridization." A total of 6575 scholarly articles were retrieved from the Google Scholar database. Four publications were retrieved from PubMed, 214 from ScienceDirect, and 765 from ResearchGate.

The pertinent literature was subjected to a two-tiered screening process consisting of practical and methodological screenings. A total of 146 literatures were successfully sorted from the two stages, while a significant number of 7409 literatures did not meet the predetermined criteria and were consequently excluded from the analysis. Subsequently, the pertinent literature, which has been meticulously curated and assessed in accordance with the established criteria, was subjected to a further round of scrutiny, whereby redundant findings were expunged through a process of deduplication across the four electronic search engines that were employed. Following the elimination stage based on duplication, a total of 58 pertinent documents were procured. These works were subsequently scrutinized in their entirety to assess their suitability for bolstering the synthesis process and their relevance to the research objectives. The culmination of the literature that underwent meticulous sorting and was incorporated into this comprehensive literature review amounted to a total of 37 scholarly works (Figure-1).

A total of 37 relevant literature sources were scrutinized to extract pertinent findings. These findings were subsequently classified into eight distinct categories based on their thematic similarities, as presented in Table-1 [10–44]. After this, the discoveries emanating from each classification were subjected to interpretation to amalgamate novel findings. The results obtained from the analysis of each category were compiled and expounded on in the ensuing discourse.

Discussion

Many hazards linked to the consumption of quail eggs and meat products have been identified across diverse domains, encompassing public health concerns regarding the potential for foodborne disease and conservation issues that may exacerbate its spread. Moreover, it is crucial to recognize that economic and political factors significantly influence the emergence of obstacles in the conservation domain (Figure-2).

Bacterial diseases

It has been ascertained that there are three confirmed bacterial strains in quail products. The quail commodities encompass both quail meat and egg products ubiquitously ingest by the human

Table-1: Findings' categories.

S. No.	Category	References
1.	Campylobacteriosis in humans due to consumption of quail	[10–17]
2.	Salmonellosis in humans due to consumption of quail	[18–23]
3.	Colibacillosis in humans due to consumption of quail	[24–27]
4.	Avian influenza in humans due to consumption of quail	[28–32]
5.	Toxoplasmosis in humans due to consumption of quail	[33–35]
6.	Coturnism	[36–40]
7.	Accumulation of lead quail meat products	[41–43]
8.	One Health aspect related to the consumption of quail	[6, 43, 44]

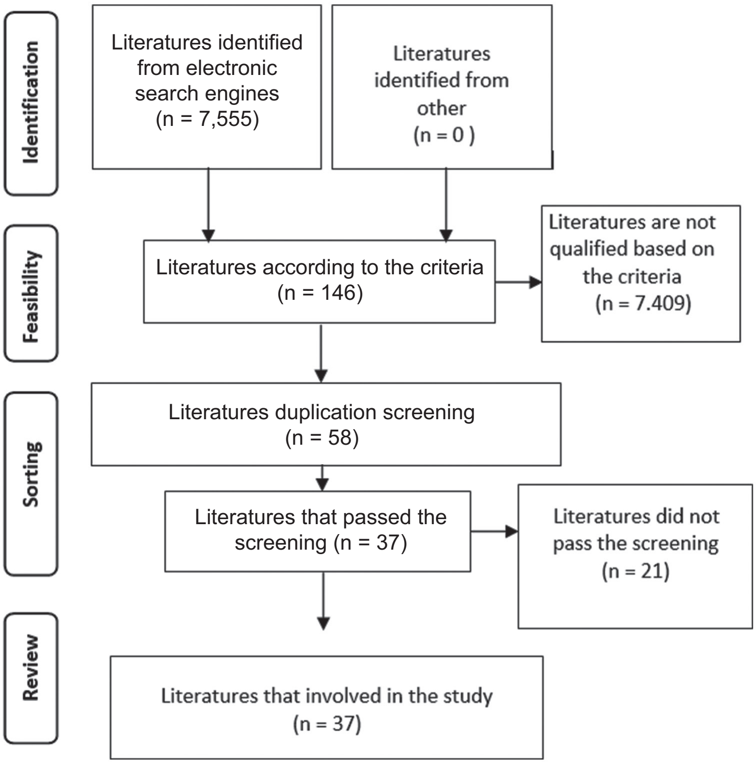

Figure-1: Schematic representation of the literature screening process.

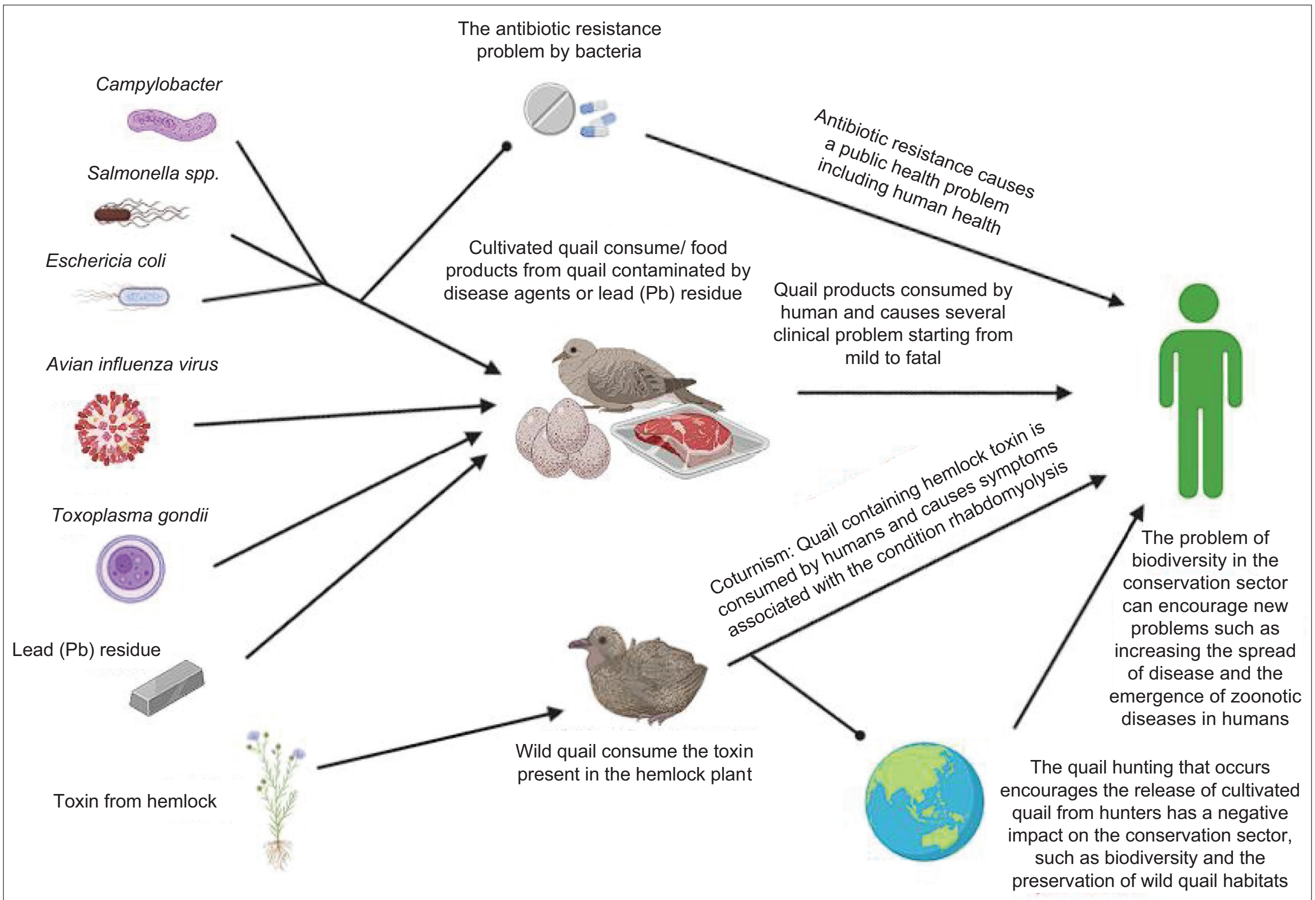

Figure-2: Problem risk scheme from the consumption of quail products.

population. The trinity of bacterial pathogens frequently associated with human foodborne illnesses are *Campylobacter*, *Salmonella* spp., and *Escherichia coli*. The aforementioned bacterial agents, namely, *E. coli*, *Salmonella* spp., and avian pathogenic *E. coli*, are known to cause colibacteriosis, salmonellosis, and colibacillosis in humans, respectively. The clinical manifestations of these zoonotic infections may vary from mild to severe, and in some cases, they may even lead to fatality. Furthermore, the administration of antimicrobial agents as a therapeutic intervention for these bacterial infections gives rise to a novel predicament, namely, antimicrobial resistance, which poses a significant challenge to the well-being of the general populace.

The evidence of the potential transmission of bacterial pathogens to humans through the consumption of quail meat and egg products is substantiated by research studies that have effectively isolated bacterial strains from quail carcasses and eggs. The findings of Cox *et al*. [15], Joaidi-Jafari *et al*. [16], and Sabzmeydani *et al*. [17] indicate the presence of *Campylobacter* in both quail eggs and carcasses, with an average prevalence of 30.45% and 14%, respectively. Concurrently, it has been demonstrated through research conducted by esteemed scholars Jahan *et al*. [20] and Bata *et al*. [22] that *Salmonella* spp. has yielded a positive result in quail carcasses and eggs, with a prevalence of 13.33% and 1.25%, respectively. Studies conducted by Alizade *et al*. [23], Ibrahim [25], and Sauring *et al*. [26] have demonstrated affirmative outcomes in isolating *E. coli* from quail carcasses and eggs. The average prevalence rate was found to be 38.05% for carcasses and 6.7% for eggs. Based on the findings of these investigations, one may infer that quail-derived meat and egg commodities harbor the potential to disseminate bacterial pathogens to the human population, thereby constituting a significant menace to the collective well-being of society.

The mitigation of bacterial dissemination can be achieved through various measures, including the administration of antimicrobial agents. Notwithstanding, as a result of inadequate regulation and supervision, there are numerous unbridled applications of antibiotics that engender novel predicaments, such as antibiotic resistance, which can imperil the well-being of the populace, particularly in the realm of food safety [11]. The findings presented are corroborated by a body of literature, including but not limited to the works of Cox *et al*. [15], Sabzmeydani *et al*. [17], Hatta and Ratnawati [19], Jahan *et al*. [20], Omoshaba *et al*. [21], Bata *et al*. [22], and Ibrahim [25], which have demonstrated the presence of bacterial resistance in isolates obtained from quail carcasses and eggs. The transmission of antibiotic-resistant bacteria to humans through the consumption of quail meat and egg products is a matter of serious concern for public health.

Viral diseases

The pathogen responsible for avian influenza, a zoonotic disease, has been identified as avian influenza viruses (AIVs), which have been detected in quail meat and egg products. Avian influenza virus is a subtype of the influenza A virus that is known to propagate in avian species. However, there have been instances where it has caused outbreaks in domesticated birds and has also been reported to cause severe infections in humans, which can prove fatal. Notably, the AIV comprises a subtype encompassing a conglomeration of 16 distinct hemagglutinins, ranging from H1 to H16, and nine neuraminidase variants, spanning from N1 to N9. The subtypes A/H5, A/H7, and A/H9 have been demonstrated to exhibit infectivity in human populations. Since 2003, there have been reports of human infection with the AIV, specifically the H5N1 subtype. Meanwhile, the prevalence of the H9N2 subtype continues to escalate. Notably, the viruses in question exhibit a marked affinity for receptors that are abundantly expressed in the lower respiratory tract of human beings, specifically saccharides that terminate in sialic acid-α2,3-galactose. The respiratory tract infection with AIV has been observed to inflict harm upon the lungs and incite a cytokine storm, which can prove to be lethal. The mortality rate of the avian influenza H5N1 subtype in humans has been reported to range between 48% and 60%. Furthermore, it is noteworthy that in the human population, this particular ailment has the potential to elicit a range of clinical manifestations, including but not limited to conjunctivitis, pneumonia, diarrhea, vomiting, abdominal pain, encephalitis, and influenza-like illness [27–29].

The documentation of the transmission of AIV to humans remains unclear. In addition to direct contact and airborne contamination, it has been theoretically demonstrated that AIVs can be transmitted through food products [27, 28]. The potential for zoonotic transmission of avian influenza to humans through the consumption of quail meat and egg products has been substantiated by a series of studies conducted by esteemed researchers in the field, including Helmi *et al*. [29], Promkunrod *et al*. [30], and Mehrabadi *et al.* [31]. These researchers have successfully isolated AIVs in quail and have conducted extensive investigations into the subtypes of AIVs that have been identified. Based on the findings of prior research, it can be inferred that certain subtypes of AIVs, including those with high pathogenicity, have the potential to be transmitted to humans.

Parasitic diseases

The parasitic agent of disease is a significant concern for both animals and humans. The potential for parasitic disease transmission through the consumption of animal-derived food products arises from the ability of these parasites to infect both the animals and the humans that partake of them. Prior research has demonstrated the presence of *Toxoplasma gondii*, a parasitic organism, in both the meat and eggs of quail. *Toxoplasma gondii* infection in humans can lead to the onset of toxoplasmosis, a well-known zoonotic ailment that can bring about complications in fetal growth and development. This can result in various clinical manifestations, including congenital anomalies, miscarriage, and hydrocephalus in humans.

The acquisition of toxoplasmosis in humans may arise from the consumption of undercooked meat, raw vegetables, and contaminated water. The previous studies have investigated the potential presence of the *T. gondii* parasite in quail, which is a known source of sustenance for humans. In the study conducted by Taher *et al*. [33], utilizing histopathological test methods and enzyme-linked immunosorbent assay, a *T. gondii* detection test was performed on 30 quails and 92 blood samples from women who had abortions in Sihag province, Egypt. The results indicated that 10% of the quail and 48.9% of the serum samples from women who had abortions tested positive for *T. gondii*. The results of the histopathological examination conducted on quail specimens revealed that 6.7% (2 out of 30) of the liver, 3.3% (one out of 30) of the brain, and 6.7% (two out of 30) of the lungs exhibited histopathological lesions.

In a comparable study conducted by Cong *et al*. [34], it was observed that quail in six cities across China exhibited a prevalence rate of 9.52% (59 out of 620) for *T. gondii* infection. Furthermore, an assay for the detection of *T. gondii* in quail eggs as a comestible derived from quail has been conducted. The research undertaken by Khademi *et al*. [45], whose objective was to identify the presence of *T. gondii* in eggs prevalent in the community, involved the collection of 200 industrial and local eggs, which were subsequently subjected to a polymerase chain reaction and restriction fragment length polymorphism techniques targeting the SAG3 gene. This examination revealed that 11% (22 out of 200) of the specimens were positively infected with *T. gondii*. According to the conducted studies, it has been demonstrated that food products derived from quail eggs and meat can potentially serve as a transmission pathway for toxoplasmosis in humans.

Metabolic diseases

The consumption of quail meat and egg products poses two metabolic disease risks concerning human health: Coturnism incidence and heavy metal accumulation, particularly lead in quail. Coturnism is a condition of human poisoning resulting from the consumption of quail that have ingested plants containing toxic substances for humans. The manifestation of coturnism is observed in the consumption of *Coturnix coturnix coturnix*, commonly known as the European quail. This avian species exhibit partial migration tendencies within its population. The annual transcontinental migration of European quail from their wintering grounds in Africa to their breeding grounds in Europe commences in February, coinciding with winter waning. Conversely, during the months of August through October, the reverse migration of European quail from Europe to Africa takes place. Notably, coturnism, a condition characterized by clinical symptoms associated with rhabdomyolysis, has been observed in humans during the migration of quail from the northern regions of Europe to the southern regions of Africa. This phenomenon is recognized as one of the contributing factors to the incidence of rhabdomyolysis. Rhabdomyolysis is a pathological state characterized by the breakdown of skeletal muscle fibers, releasing intracellular contents into the bloodstream. This phenomenon can elicit a range of clinical manifestations, including but not limited to muscle weakness, edema, myalgia, spasms, and dark-colored urine. Furthermore, it is noteworthy that the occurrence of rhabdomyolysis at an advanced stage may give rise to a plethora of clinical manifestations, including but not limited to electrolyte imbalances, acid-base disturbances, coagulopathies, hypovolemia, myoglobinuria, and acute kidney injury [35, 37].

The etiology of coturnism remains elusive; however, it is postulated that the manifestation of coturnism is intricately linked to the presence of coniine in the botanical fare ingested by the European quail. Notably, the European quail exhibits a phase of hyperphagia antecedent to its migratory sojourn, during which it endeavors to amass copious amounts of sustenance to stockpile energy reserves. The phenomenon in question pertains to the repeated occurrence of a hyperphagic phase in European quail during migration. When the avian species experiences a depletion of energy reserves, it ceases its migratory journey and endeavors to locate sources of sustenance to fuel the hyperphagic phase, thereby facilitating the continuation of its migration. During this particular phase, it is noteworthy that European quail, being omnivorous in nature, exhibits a diverse dietary pattern encompassing a wide range of vegetation, seeds, invertebrates, and plants, including those that may contain toxic substances. Numerous instances of coturnism have been documented in Europe, which can be attributed to the intersection of the migratory route and distribution of European quail with the distribution of hemlock or *Conium maculatum* plants across various regions such as Europe, North Africa, East Asia, North America, South America, Australia, and New Zealand. These plants are widely regarded as the primary etiological factor for coturnism. The botanical specimen Hemlock is known to harbor a variety of alkaloids that exhibit toxicity toward humans. Coniine is one of the principal alkaloids found in the hemlock plant. Coniine is a derivative alkaloid of a polyketide nature that exhibits toxicological effects on both human and animal populations. Coniine acting as a nicotinic acetylcholine receptor antagonist, can lead to the inhibition of the nervous system, ultimately resulting in a fatality. One of the mechanisms of action of these alkaloids entails the stimulation of respiration, which subsequently leads to respiratory depression, cyanosis, and ultimately fatality [35, 36, 38].

The incidence of foodborne disease stemming from the consumption of European quail has emerged as a significant concern, particularly within the hunting community, given the European quail's status as a game species. Throughout the annals of history, instances of coturnism have been documented, persisting into the contemporary era. Tsironi *et al*. [37] have recently reported on three cases of patients who exhibited rhabdomyolysis after the consumption of quail that had consumed plants containing toxins during the autumnal migration of European quail. Furthermore, Korkmaz *et al*. [36] reported that a significant proportion of individuals, specifically 40%, who ingested the same quail exhibited symptoms of rhabdomyolysis, including but not limited to myalgia, arthralgia, emesis, and nausea. In the interim, Gokhan *et al*. [39] have documented a case involving a 58-year-old male presenting with symptoms of myasthenia, myalgia, emesis, and dark urine, which manifested within a 4-h window after the consumption of quail. On conducting laboratory analyses, it has been determined that the subjects in question [36, 37, 39] exhibited anomalies in renal function, myoglobinuria, and proteinuria.

The potential for metabolic risk in quail meat and egg products lies in the accumulation of heavy metals. The issue of heavy metal concentration in food products has emerged as a significant concern in the realm of food safety, with potential implications for the health of consumers. It has been observed that overindulgence in heavy metals may lead to a range of health complications, including but not limited to hypertension and cancer. A multitude of heavy metals that exhibit environmental persistence, among which is lead (Pb), a toxicant that is known to elicit a range of deleterious health outcomes. It has been observed that the human body may manifest disorders of various physiological functions, including but not limited to the nervous, cardiovascular, hematological, and reproductive systems, on exposure to excessive levels of Pb. Excessive Pb exposure in pregnant women can lead to impaired fetal development. The accumulation of Pb within the human body can give rise to a multitude of health issues through various mechanisms. These include the induction of glutathione addition, which can lead to oxidative stress, disruption of cell membranes due to lipid peroxidation resulting in hemolytic anemia, and an increase in the number of neurotransmitters that can cause organ damage and even fatality, as evidenced by previous studies by Debnath *et al*. [40] and Ahmed *et al*. [42].

It is a well-established fact that the human body is often exposed to Pb through food products. This is primarily due to Pb residues in the livestock environment, which contaminate the livestock and is eventually consumed by humans. An investigation conducted by Darwish *et al*. [41] revealed that the concentrations detected in cultured quail tissue, ranging from 0.05 ppm to 1.96 ppm, are relatively elevated compared to other heavy metals, such as cadmium and arsenic. This condition is directly proportional to the high Pb concentrations found in feed, water, and quail cages. The potential for Pb transmission into the bodies of quails exists through inhalation as well as oral routes, including through feed and drinking water. The potential correlation between Pb utilization in water pipe manufacturing and the pollution of Pb content in the livestock milieu is a subject of considerable interest. Including bone and fish components in feed is among the pathways through which contamination is transmitted to the avian body, specifically in quails. Evidently, there is a potential hazard of foodborne illness arising from the buildup of Pb in quail-derived commodities, particularly those pertaining to quail meat. Furthermore, it is noteworthy that appropriate management of cages can significantly impact pollution levels. A comparative analysis by Ahmed *et al.* [42] on Pb concentrations in quail, utilizing both battery cage rearing and deep litter systems, revealed that the concentration of Pb in quail subjected to a battery cage was greater than that of quail raised in a deep litter system. The highest concentrations of Pb were detected in the kidneys, liver, and muscles of quails under the battery cage [41, 42].

This observation highlights the potential for zoonotic transmission of foodborne diseases stemming from the bioaccumulation of Pb in quail-derived comestibles, with particular emphasis on quail meat products. In the interim, it is imperative to undertake investigations pertaining to the potential hazard of heightened Pb exposure through the accrual of quail egg commodities.

Potential foodborne diseases from the consumption of quail products within the framework of the One Health concept

The employment of antibiotics in animal husbandry, which leads to the development of resistance in the food industry, has emerged as a pressing One Health concern. The unregulated utilization of quail may lead to deleterious health outcomes. Nevertheless, the issue at hand extends beyond its initial scope, as the emergence of resistance can escalate into a more significant predicament, thereby engendering public health implications that pertain to both human and animal welfare and environmental conditions. In light of the concern surrounding antibiotic resistance, it is imperative to address the matter of foodborne zoonotic diseases stemming from the consumption of quail products. As a One Health issue, the health of animals and humans is inextricably linked, and environmental contamination further exacerbates the potential for adverse health outcomes. In the context of the intricate One Health paradigm, certain predicaments possess the capability to transcend multiple domains, pertaining to the prevalence of coturnism.

Regarding coturnism, it is noteworthy that hunting is the primary etiological factor for human consumption of wild quail. It has been postulated that two subspecies of the *C. coturnix* quail species are implicated in the hunting practices observed in Europe. Notably, the distribution of the two subspecies of *C. coturnix* is generally demarcated into two extensive regions. The distribution range of *C. coturnix coturnix*, commonly known as the European quail, encompasses the regions of Europe, the Maghreb, and West Asia.

On the other hand, *Coturnix coturnix japonica*, the wild Japanese quail, is predominantly found in East Asia. Nevertheless, it is noteworthy that in certain geographical regions, such as the Baikal territory in Russia and the Kentei region in Mongolia, these two distinct subspecies coexist and exhibit the potential for interbreeding or hybridization. Furthermore, the reduction in the European quail population as a game species has instigated the introduction of farmed quail by hunters in Europe to uphold the viability of the hunting sector, which holds significant economic importance.

The assemblage of liberated domesticated quail encompasses diverse subspecies, ranging from the European and Japanese quail to interspecific hybrids of the aforementioned subspecies. The phenomenon in question leads to an elevation in the frequency of hybridization events between the two distinct subspecies, thereby engendering novel challenges to the welfare of the populace, particularly within the realm of preservation. The introgression of genes between subspecies can lead to alterations in the phenotypic expression of quail, including but not limited to changes in body size, feather color, sexual behavior, and migratory behavior. These changes may have a detrimental impact on the survival of quail in their natural habitat, potentially leading to a decline in population numbers. Furthermore, the disturbance of indigenous adaptation and the creation of hybrid assemblages among European quail populations could potentially impede the innate behavior of European quail populations. The phenomenon of interbreeding between these two subspecies has been postulated as a contributing factor to the observed reduction in the number of quail populations undertaking seasonal migration to Africa [6, 43, 44].

Huisman has conducted investigations pertaining to the proportion of hybrids within the European quail population situated in northeastern Spain during 3 distinct years, namely, 1999, 2002, and 2005. The present inquiry was conducted by identifying genotypes in the gathered quail plumage. The findings of the inquiry have revealed that hybrids and genotypes of indigenous Japanese quail were detected in approximately 5%–15% of the specimens. The study conducted by Barilani *et al*. [6] endeavors to detect hybridization events in both natural and domestic settings through the utilization of mitochondrial deoxyribonucleic acid (mtDNA) and nuclear DNA (microsatellite) analyses, as well as Bayesian mixed DNA marker techniques.

The present analysis has revealed the existence of two major mtDNA clades that are consistent with the respective subspecies and the detection of hybridization events in wild quail specimens collected from diverse geographic locations, such as Spain, Italy, Senegal, and Mongolia. It is evident that there has been a phenomenon of gene introgression between the two subspecies, and furthermore, the hybrids' distribution has extended beyond the confines of Europe. In light of the current threat to biodiversity, it is noteworthy that certain nations, including Portugal, France, and Greece, have implemented a prohibition on the release of quail. Notably, the policies pertaining to the release of quails in Spain exhibit regional variations, with certain areas exclusively releasing farmed European quails. Notwithstanding, it is noteworthy that the European quail, being a subspecies of quail, poses a formidable challenge in terms of captive breeding. It is plausible that the release of hybrids between the European quail and the Japanese quail may have occurred. Henceforth, the esteemed scholars Sanchez-Danoso *et al*. [44] have undertaken a comprehensive investigation aimed at discerning genotypes in quail that are reared for release, utilizing the highly efficacious microsatellite marker methodology in the region of Spain. The findings of this study indicate that a predominant genotype of Japanese quail was detected in over 85% of the samples, as reported in the previous studies by Barilani *et al*. [6], Huisman *et al*. [43] and Sanchez-Danoso *et al*. [44].

The ongoing practice of quail release poses a significant threat to biodiversity and remains a pressing concern within the conservation sector. Furthermore, the amalgamation of genetic material between European quail, which typically inhabit natural environments, and Japanese quail, a species commonly domesticated by humans, augments the likelihood of pathogen dissemination. The phenomenon of continuous allelic introgression in both subspecies may potentially instigate genetic mutations in disease agents, thereby expediting the adaptation of these agents in each subspecies, including humans, who frequently interact with and consume quail as both cultivated and hunted animals. The heightened propensity for disseminating this ailment poses a significant risk to the populace, particularly in the realm of comestible security, given the ubiquitous consumption of quail by humans. The extensive geographical range of hybrid genotypes in Africa underscores the possibility of their global dissemination. Henceforth, it is imperative that all regions remain vigilant toward the potential hazards of conservation threats and the dissemination of diseases associated with interbreeding. It is imperative that we strive for the ongoing enhancement of comprehensive regulatory supervision pertaining to the liberation of quail, with the ultimate goal of mitigating potential hazards.

Conclusion

There exist numerous potential hazards of foodborne diseases stemming from the ingestion of quail products, encompassing bacterial ailments such as campylobacteriosis, salmonellosis, and colibacillosis; viral afflictions such as avian influenza; parasitic conditions such as toxoplasmosis; and metabolic disorders, including coturnism and Pb accumulation. In the realm of bacterial diseases, the injudicious employment of antibiotics, particularly in the domain of livestock, engenders antibiotic resistance, thereby exacerbating the public health predicament. The vast majority of the hazards associated with these zoonotic illnesses possess the capacity to elicit deleterious health outcomes across all geographic locales. It is worth noting that coturnism is an exceptional occurrence that is limited to the distribution area of European quail and hemlock plants. The phenomenon of release, which leads to heightened crossbreeding between European and Japanese quail, results in gene introgression between the two subspecies. This, in turn, poses a heightened risk of disease transmission and the emergence of novel diseases. Furthermore, it is imperative to acknowledge that the persistent interbreeding among quails poses a significant challenge to both conservation efforts and the economic viability of the quail hunting industry.

Authors' Contributions

TTKA, SAM, and GLU: Conceptualization and methodology. RLB and GLU: Validation and writing—review and editing. TTKA and SAM: Formal analysis, investigation, resources, data curation, and writing—original draft preparation. SAM: Visualization. TTKA, RLB, and GLU: Supervision. All authors read and approved the final manuscript.

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Competing Interests

The authors declare that they have no competing interests.

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