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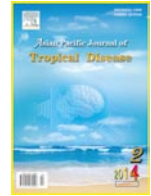
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A survey of bacterial and mold contamination of imported rice into West Azerbaijan Province, northwest of Iran

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ABSTRACT

Objective: To investigate contamination of imported rice with mold and *Bacillus cereus* in Iran as bacteria, fungi and viruses are main causes of food-borne diseases.

Methods: In this study, mildew colonies of *Bacillus cereus* and organoleptic properties of 17 brands of imported rice into Iran were measured, out of which 24 samples were prepared according to national standards.

Results: All the 408 samples had positive mold and *Bacillus*; but, they were in the normal range. All the samples (408) of normal color and morphological features were granular.

Conclusions: The results of our study shows that imported rice to Iran contaminated by microbials due to the storage conditions. Although the contamination of imported rice is permissible, it is necessary to monitor food hygiene and healthy food pictures for as required.

1. Introduction

Consumption of contaminated food is possibly associated with transmission of pathogens including bacteria, viruses and parasites into human body[1]. It is estimated that 30% of people in industrialized countries suffer from diseases caused by food, at least once a year[2]. Reports from UK and USA have suggested that 20% to 40% of diseases are caused by ingestion of contaminated food[3]. National health agencies have reported that average prevalence of food-borne diseases in EU and third world countries is 3.38 and 8.915 cases per 100000 people respectively. Annual cost of food-borne diseases including direct medical costs and efficiency decline is 5 to 6 billion dollar[4]. Rice is among the most valuable cultivated crops with a long history which

is the world's important food crop today[5]. Rice with no husk as the main diet of seeds may be related to a variety of fungal infections[6]. Rice is a type of food products that is susceptible to fungal and bacterial infections. *Bacillus cereus* (*B. cereus*) is also a cause of nosocomial infection[7].

B. cereus is an aerobic-anaerobic bacterium which is a bug of spore. This bacterium exists in rice, vegetables, meat (raw and processed), grain-based soups and milk and milk products and is considered one of the causes of food poisoning. *B. cereus* can cause two types of poisoning: one is symptoms of diarrhea and the other is vomiting. Other symptoms are caused by two types of enterotoxin produced by the bacterium[8–12]. To control *B. cereus*, traditional and herbal therapies are used[13].

Fungal growth on different foods, in addition to reducing quantity of food due to the elimination of their infected part, reduces their nutritional value. The secondary metabolites of fungus on foods are known as mycotoxins or fungal toxins which putting on the event. In the case of severe damaging effects, these chemicals on living organisms can

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cause carcinogenicity, malformations, growth retardation, suppressed immune systems and may create mutagenesis. Relatively resistant mycotoxinogenic, mycotoxins or fungal toxins are a group of the metabolites of toxins fungi and fungal cells produced by secondary metabolic pathways, and probably in food production and caused environment pollution^[14–17]. Mold represents a potential risk for humans due to their ability for the production mycotoxins in food that can be produced when the environmental conditions be appropriate^[18].

Conditions such as humidity and inappropriate storage lead to growth of mold. Thus, in the present study, considering high consumption of rice, bacterial and fungal contamination of imported rice was studied.

2. Materials and methods

2.1. Sampling

In this study, 24 rice samples were prepared and tested from each of the 17 brands.

2.2. Enumerating molds

Enumeration of colony of mold was used as the standard method for counting the number 1 and 2–10899 (LQS–W5051126 and 127).

Also, to enumerate the mold, colony counting method with No. 10899–1 was applied.

A total of 5 g of rice was mixed in 45 mL of Ringer's solution prepared by diluting with 0.1 of the sample. A total of 0.1 mL of the prepared suspension was placed on the plates containing DG 18 Agar by swab and incubated for 18–24 h at 30 °C. The bacterial colonies were calculated by the following formula^[19].

$$N = \sum a/V (n1+0.1n2) d$$

Where, $\sum a$ means total colony count of *B. cereus* on the selected plates, V is total inoculated on each plate per mL, $n1$ is the first dilution plate count number of selected, $n2$ is the second count of the number plate of the selected dilution, d is dilution factor according to the selected dilution^[19].

3.1. Enumerating the bacteria

Also, to enumerate *B. cereus*, colony counting method with No. 2324 (LQS–W505117) was applied. A total of 5 g of rice was mixed in 45 mL of Ringer's solution which was prepared by dilution with 0.1 of the sample. A total of 0.1 mL of the prepared suspension was placed on the plates containing cereus selective agar by swab and incubated for 18–24 h at 30 °C. The bacterial colonies was calculated by the following formula^[20]:

$$N = \sum a/V (n1+0.1n2) d$$

Where, $\sum a$ is total colony count of *B. cereus* on the selected plates, V is total inoculated on each plate per mL, $n1$ is the first dilution plate count number of selected, $n2$ is the second count of the number plate of the selected dilution, d is dilution factor according to the selected dilution^[20].

3. Results

Mold colony count was positive for the 408 samples of

imported rice and 408 samples of *B. cereus* and 100% of the samples were contaminated. While mold-contaminated rice in various brands, all of 408 samples were in the range below of acceptable limits (standard acceptable level of mold-contamination was considered 10^4 CFU/g). All the rice samples (17 brands) were contaminated with *B. cereus*, which was below the acceptable limits (standard acceptable level for contamination with *B. cereus* was 10^3 CFU/g).

4. Discussion

Findings of the present study showed that all the samples had fungal infection; however, range of their contamination was normal. All the samples were contaminated with *B. cereus*, which was within the normal range. Results of organoleptic characteristics of rice were also normal.

The results by Kazemi *et al.* (2009) indicated that 137 samples of imported rice were contaminated with various fungi such as *Penicillium*, *Aspergillus* and *Fusarium*^[17].

Moreover, 41% of the rice samples had bacterial contamination^[17]. Studies in Egypt, Turkey and Jordan in the field of fungal contamination of rice have isolated fungal species belonging to the genera *Aspergillus*, *Penicillium* and *Paecilomyces* and aflatoxin contamination of the samples has also been revealed^[22]. Okhovvat *et al.* conducted a study on contamination of imported grain with fungi, such as *Aspergillus*, *Penicillium* and *Fusarium*^[23].

Normal contamination of the present samples was probably due to their storage conditions.

Most of the known toxin products derived from acetate or amino acid by fungal species belong to genera of *Aspergillus* sp., *Fusarium* sp., *Penicillium* sp. and *Stachybotrys* sp. *Claviceps* sp., *Phoma* sp., *Mirothecium* sp. and *Diplodia* sp. are produced. Most of the fungi which generate mycotoxins well grow in warm and humid climatic conditions and secrete substantial amounts of toxin products^[24–27].

FAO of the damage caused by pollution to micro and macroorganism of grain enters the national wealth worldwide, about 10 percent of total food production is estimates^[14]. Results of Aghili *et al.*'s (2012) work showed that the percentage of instances in at least one of the plates and showed fungal contamination of grain. The genera *Aspergillus* (43.96%), *Cladosporium* (13.96%), *Alternaria* (10.21%), *Rodotrola* (7.50%) and *Penicillium* (4.79%) were the most common fungal isolates^[6].

The pathogens have creation different disorder and problem for human^[28–34]. Seemingly, grain mold infection always happens. Normal contamination of the present samples was probably due to storage conditions of these products. Observing hygiene principles and using clean land for cultivating cereal grains could decrease pollution of the cereal.

Conflict of interest statement

We declare that we have no conflict of interest.

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