Fungal contamination of produced wheat flour in West Azerbaijan, northwest of Iran

Jafar Asadzadeh¹, Ramin Teymori¹, Naser Ghazanfarirad¹, Maryam Fakhernia¹, Nasrin Haghighat-Afšar¹, Maryam Blouki¹, Aghakhan Kheiri¹, Hassan Hassanzadazar¹, Mahmoud Bahmani¹,²

¹Deputy for Food and Drug, Urmia University of Medical Sciences, Urmia, Iran
²Food and Beverages Safety Research Center, Urmia University of Medical Sciences, Urmia, Iran

1. Introduction

In recent years, the use of proteins with plant sources is recommended more than previously in diet. Consumption of these proteins is cheaper than animal source. Reduction in saturated fats intake can prevent chronic diseases, particularly cardiovascular disease, diabetes, renal failure, hyperlipidemia, cancer and osteoporosis[1].

Wheat is a strategic and important crop in human life. As one of the most consuming agriculture crops, it can play an important role in endangering human health if contaminate with pollutants.

Wheat flour is commonly used for baking bread that almost is used in all meals of Iranian food culture. Prepared foods of cereals such as breads are inexpensive with high nutritional value in diet[2].

The use of bread made from whole wheat flour or high extracted rate flouris recommended due to higher levels of fiber, minerals and vitamins[3]. Advancement of world health culture, Food science and technology and food hygiene caused declining of microbial and chemical food infection or toxicosis with exception of fungal contamination of foods. The aim of this study was investigation of fungal contamination of wheat flour...
produced in West Azerbaijan province of Iran.

2. Methods and materials

2.1. Sampling

A descriptive study was done since March 2011 to April 2013 in flour mills in West Azerbaijan province of Iran. Randomly, 151 samples of produced wheat flour from 17 plants were collected and sent to laboratory. Microbial total count and molds were counted, according to Iran national standard No. 2393 for assessment flours microbial count[4].

2.2. Methods

At first 5 g of flour samples were mixed in 45 mL Ringer solution (0.1) and serial dilution prepared (10⁻¹ to 10⁻⁵).

2.3. Total count

A total of 1 mL of the desired dilution (10⁻¹ to 10⁻⁵) plated in sterile plate count agar culture mediums and incubated at 30 °C for 24–48 h.

2.4. Mold count

A total of 1 mL of the desired dilution (10⁻¹ or 10⁻²) distributed on the plate count agar medium and incubated at 25 °C for 5–3 d.

3. Results

All samples were clean with no microbial and fungal contamination. Obtained results were showed in Table 1.

Table 1
Number, permissible levels mold (Standard No. 2393), test results and acceptable or unacceptable for samples.

| Number | Permissible levels mold (Standard No. 2393) | Test results | Acceptable or unacceptable |
|--------|--------------------------------------------|--------------|-----------------------------|
| 1      | 5×10⁴                                 | <10³         | acceptable                  |
| 2      | 5×10⁴                                 | <10³         | acceptable                  |
| 3      | 5×10⁴                                 | <10³         | acceptable                  |
| 4      | 5×10⁴                                 | <10³         | acceptable                  |
| 5      | 5×10⁴                                 | <10³         | acceptable                  |
| 6      | 5×10⁴                                 | <10³         | acceptable                  |
| 7      | 5×10⁴                                 | <10³         | acceptable                  |
| 8      | 5×10⁴                                 | <10³         | acceptable                  |
| 9      | 5×10⁴                                 | <10³         | acceptable                  |
| 10     | 5×10⁴                                 | <10³         | acceptable                  |
| 11     | 5×10⁴                                 | <10³         | acceptable                  |
| 12     | 5×10⁴                                 | <10³         | acceptable                  |
| 13     | 5×10⁴                                 | <10³         | acceptable                  |
| 14     | 5×10⁴                                 | <10³         | acceptable                  |
| 15     | 5×10⁴                                 | <10³         | acceptable                  |
| 16     | 5×10⁴                                 | <10³         | acceptable                  |
| 17     | 5×10⁴                                 | <10³         | acceptable                  |
| 18     | 5×10⁴                                 | <10³         | acceptable                  |
| 19     | 5×10⁴                                 | <10³         | acceptable                  |
| 20     | 5×10⁴                                 | <10³         | acceptable                  |
| 21     | 5×10⁴                                 | <10³         | acceptable                  |
| 22     | 5×10⁴                                 | <10³         | acceptable                  |
| 23     | 5×10⁴                                 | <10³         | acceptable                  |
| 24     | 5×10⁴                                 | <10³         | acceptable                  |
| 25     | 5×10⁴                                 | <10³         | acceptable                  |
| 26     | 5×10⁴                                 | <10³         | acceptable                  |
| 27     | 5×10⁴                                 | 2×10⁴        | acceptable                  |
| 28     | 5×10⁴                                 | <10³         | acceptable                  |
| 29     | 5×10⁴                                 | <10³         | acceptable                  |
| 30     | 5×10⁴                                 | <10³         | acceptable                  |
| 31     | 5×10⁴                                 | <10³         | acceptable                  |
| 32     | 5×10⁴                                 | <10³         | acceptable                  |
| 33     | 5×10⁴                                 | <10³         | acceptable                  |
| 34     | 5×10⁴                                 | <10³         | acceptable                  |
| 35     | 5×10⁴                                 | <10³         | acceptable                  |
| 36     | 5×10⁴                                 | 5×10³        | acceptable                  |
| 37     | 5×10⁴                                 | <10³         | acceptable                  |
| 38     | 5×10⁴                                 | <10³         | acceptable                  |
| 39     | 5×10⁴                                 | <10³         | acceptable                  |
| 40     | 5×10⁴                                 | <10³         | acceptable                  |
| 41     | 5×10⁴                                 | <10³         | acceptable                  |
| 42     | 5×10⁴                                 | <10³         | acceptable                  |
| 43     | 5×10⁴                                 | <10³         | acceptable                  |
| 44     | 5×10⁴                                 | <10³         | acceptable                  |
| 45     | 5×10⁴                                 | 1×10⁴        | acceptable                  |
| 46     | 5×10⁴                                 | <10³         | acceptable                  |
| 47     | 5×10⁴                                 | <10³         | acceptable                  |
| 48     | 5×10⁴                                 | <10³         | acceptable                  |
| 49     | 5×10⁴                                 | <10³         | acceptable                  |
| 50     | 5×10⁴                                 | <10³         | acceptable                  |
| 51     | 5×10⁴                                 | 3×10³        | acceptable                  |
| 52     | 5×10⁴                                 | 2×10⁴        | acceptable                  |
| 53     | 5×10⁴                                 | 10³          | acceptable                  |
| 54     | 5×10⁴                                 | 10³          | acceptable                  |
| 55     | 5×10⁴                                 | 10³          | acceptable                  |
| 56     | 5×10⁴                                 | 10³          | acceptable                  |
| 57     | 5×10⁴                                 | <10³         | acceptable                  |
| 58     | 5×10⁴                                 | <10³         | acceptable                  |
| 59     | 5×10⁴                                 | <10³         | acceptable                  |
| 60     | 5×10⁴                                 | <10³         | acceptable                  |
| 61     | 5×10⁴                                 | <10³         | acceptable                  |
| 62     | 5×10⁴                                 | <10³         | acceptable                  |
| 63     | 5×10⁴                                 | <10³         | acceptable                  |
| 64     | 5×10⁴                                 | <10³         | acceptable                  |
| 65     | 5×10⁴                                 | <10³         | acceptable                  |
| 66     | 5×10⁴                                 | <10³         | acceptable                  |
| 67     | 5×10⁴                                 | <10³         | acceptable                  |
| 68     | 5×10⁴                                 | <10³         | acceptable                  |
| 69     | 5×10⁴                                 | 2×10⁴        | acceptable                  |
| 70     | 5×10⁴                                 | 2×10⁴        | acceptable                  |
| 71     | 5×10⁴                                 | <10³         | acceptable                  |
| 72     | 5×10⁴                                 | <10³         | acceptable                  |
| 73     | 5×10⁴                                 | <10³         | acceptable                  |
| 74     | 5×10⁴                                 | <10³         | acceptable                  |
| 75     | 5×10⁴                                 | <10³         | acceptable                  |
| 76     | 5×10⁴                                 | <10³         | acceptable                  |
| 77     | 5×10⁴                                 | <10³         | acceptable                  |
| 78     | 5×10⁴                                 | <10³         | acceptable                  |
| 79     | 5×10⁴                                 | 1×10⁴        | acceptable                  |
| 80     | 5×10⁴                                 | 2×10⁴        | acceptable                  |
| 81     | 5×10⁴                                 | 1×10⁴        | acceptable                  |
In this study, 151 samples were negative for fungal and were in normal range. All samples taken were acceptable.

4. Discussion

The results showed that 100 samples did not have any pollution and were consumable. It showed sanity of the process of flour production in West Azarbaijan Province. Consumption of bread products without any contamination in livestock and poultry reduced the risk of mycotoxins in foods[5].

Unfavorable conditions such as storage in high temperature of flour in bakery, factory or warehouse location or whereabouts and microbial or fungal contamination of grains and flour during the manufacturing process can be effective on mycotoxin production[6].

Fungal contamination of wheat with Aspergillus species was seen in Egypt[6].

Ohkovvat et al. have done a study on imported wheat varieties to Iran and reported fungal contamination[7].

A study was done by Li et al. in India to assess gastrointestinal illness that associated with consumption of bread made of damaged wheat and their obtained results showed contamination of breads by Aspergillus and Fuzarium genus[8]. The flour products maintenance, personnel hygiene, transporting hygiene, raw materials maintenance, packaging and equipment hygiene affects on reducing corruption and microbial contamination. In all items storing should be done at temperatures below 20 °C. it's recommended that flour with best quality and low heat-resistant spores, used for white bread[9-12].

Investigation on flour samples in Tabriz bakeries showed contamination of 31.5% of 89 samples with fungi above the limit of 10³ colonies per each gram of the flour[13].

Quality control mean is development, design, manufacture and deliver high quality products and services, which use economic and consumer satisfaction is a permanent. Many people are interested to buying breads which is healthy[14-16]. Food intake possibility of transmission of pathogens (bacteria, viruses and parasites) provides the human body[17].

To prevent microbial contamination of food, educate people, and supervision of the hygiene principles in preparing, transport, storage and supply of food is
essential[18].

Previous studies were reported flour contamination but no contamination was seen in this study. The results of this study showed that production of flour in west Azerbaijan is quite hygienic. Consideration and following of health departments and authorities at all stages of production, storage and distribution of wheat flour is necessary to reduce and eliminate the fungal contamination.

**Conflict of interest statement**

We declare that we have no conflict of interest.

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