

RESEARCH ON SOME COMPOUND FEED RAW MATERIALS HAZARDS IN RELATION WITH FOOD SAFETY

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Abstract

Food safety hazards associated with compound feed can be physical, chemical and biological. The paper aims to conduct a study during 2019 and 2020, on the production of compound feed in relation on food safety, by physical analysis of samples of raw materials (corn grains, wheat grains) used in the production of compound feed from two feed mills from Romania, called in the paper "unit A" respectively "unit B". Regarding the hazards identified in unit A, it was found that in 2019, 20 lots of corn grains (68.9%) and 9 lots of wheat grains (31%) were refused, the most common hazard identified (78.5%) being represented by their high humidity. In 2020, 17 batches of raw materials were rejected, represented by corn grains (52.9%) and wheat grains (47%); humidity was also the predominant potential hazard identified (70.5%). In the case of unit B, based on physical parameters, in 2019, 22 batches of corn grains (91.6%) and two batches of wheat grains (8.3%) were refused; the most frequently identified hazard (58.3%) was the presence of sprouted and moldy grains. In 2020, 53 batches of raw materials were rejected, represented by corn grains (79.2%) and wheat grains (20.7%); the most frequently identified hazard was beetle infestation (50.9%). It can be concluded that in the production process of compound feed it is mandatory the physical analysis of raw materials to determine potential hazards; this goal is achieved in the units studied, the results highlighting the effectiveness of specific food safety control processes.

Key words: *compound feed, food safety, hazards, raw materials.*

INTRODUCTION

Food safety hazards associated with compound feed can be physical, chemical and biological. Each hazard is associated with certain sources and routes of contamination, and risk management must be based on a thorough understanding of these characteristics. Hazards may be introduced into the production process upon receipt of the raw materials or by contamination of the products during production, storage and transport. The presence of a hazard may also result from accidental or deliberate human intervention (fraud or bioterrorism) (FAO and IFIF, 2010).

The Codex Alimentarius Commission adopted the Code of Good Practice on Animal Nutrition (CAC / RCP 54-2004) which became a support for national authorities and the private sector (FAO / WHO, 2004a; FAO / WHO, 2004b).

In order to facilitate the application of the above-mentioned code, the Codex Commission has developed a document setting out guidelines for the application of feed risk assessment (CAC/GL 80-2013). In that document, risk

assessment is one of the three components of the risk analysis framework, together with risk management and risk communication.

Physical hazards are auxiliary materials or foreign objects that are not normally found in food or feed, and which could cause injury or disease. Depending on their nature, physical hazards can be classified into three groups: minerals (earth, stones, dust, metals, glass, paint flakes, etc.); plants (weeds, leaves, stems); animals (mites, insects, rodents, birds). Contaminants from the three groups listed above may occur during the harvesting of raw materials, during their storage, as well as during the processing of the finished product.

Sources of contamination with physical hazards can be divided into: raw materials, water, floors, construction and building materials, personnel (Aladjadjian, 2006).

Physical hazards such as glass, metal, sharp objects, paper and plastics can be introduced into feedstocks through raw materials, in the manufacturing process, and can be controlled or removed by sieving and other means, such as magnets for detecting metals.

The materials used for packaging are of particular importance, especially those derived from waste and/or by-products; they may come from the packaging of ingredients used as raw materials and may be inadvertently introduced into the feed manufacturing process (FAO/WHO, 2015).

Purchased raw materials in bulk are the most common source of physical contamination. Proper pre-discharge inspection is the first step in minimizing the risk of contamination. Bulk raw materials can be transported several times, in different means of transport, before reaching feed mill and being transformed into finished products. Thus, the degree of contamination of cereal seeds with foreign seeds or foreign bodies will be identified. As the composition of the batches of cereals is seldom homogeneous and certain contaminants are unevenly distributed, a sufficient number of incremental samples must be taken and homogenized to form a aggregate sample from which the laboratory sample will be obtained later.

The National Consumer Seed Grading Commission has developed the "Consumer Seed Grading Manual", approved by Order of the Minister of Agriculture and Rural Development no. 228/2017, which has the role of working tool for graders. Grading (classification) of consumer seeds is the operation of identifying and separating batches of cereals, legumes and oilseeds according to their appearance and physical condition. The structure of the grading manual for consumer seeds includes grading techniques and plans for wheat, durum wheat, rye, barley, oats, corn, flax seeds, beans, peas, sunflower, soybeans, rapeseed, saffron, seeds of mustard and rice.

The paper aims to conduct a study during the years 2019 and 2020, on the production of compound feed in relation with food safety, by physical analysis of raw materials (corn grains, wheat grains) used in the production of compound feed.

MATERIALS AND METHODS

Methodologically, the results of the analyzes performed during the reception stage of raw materials from two feed mills representative for Romania in terms of production capacity, called

in the paper "unit A" and "unit B" were processed, synthesized and interpreted; the research took place during 2019 and 2020.

The raw materials analyzed to determine the physical hazards were corn grains and wheat grains.

For physical analysis, was used as a standard "Grading Manual for Consumer Seeds" approved by Order of the Minister of Agriculture and Rural Development no. 228/2017; the analysis of the hazards of the raw materials under study was performed according to the following standards specified in the grading manual: SR EN ISO 24333:2010 - Cereals and cereal products. Sampling.; SR ISO 6639-1:1996 - Cereals and pulses. Determination of hidden insect infestation. Part 1: General principles; SR 5447:2013 Corn (*Zea mays*, L.). Specifications.; SR 13548 Common wheat (*Triticum aestivum* L.). Specifications.; STAS 6253-80 Seeds for consumption. Determination of organoleptic characteristics; SR EN 15587:2008 - Cereals and cereal products. Determination of impurities in wheat (*Triticum aestivum* L.), durum wheat (*Triticum durum* Desf.), Rye (*Secale cereale* L.) and fodder barley (*Hordeum vulgare* L.); SR fprEN 16378: 2013 - Cereals. Determination of impurities in maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* L.).

The results obtained were compared with the values regulated by national legislation. The interpretation of the results led to the formulation of conclusions concerning the production of compound feeds in relation on food safety.

RESULTS AND DISCUSSIONS

The results of the physical analyzes carried out in 2019 in unit A for the raw material samples (grain maize and wheat grain) were ordered according to the month in which they were identified (Table 1). Potentially unsafe products identified are those which did not meet the limits set by the standards in the Consumer Seed Grading Manual, or which did not comply with the quality requirements of the contracts concluded with suppliers, and which may have an negative effect on the safety of compound feed.

Table 1. Hazards identified at reception of raw materials from Unit A in 2019

| No. | Date | Product | Description of hazard | Correction |
|-----|---------|-------------|--------------------------|-----------------|
| 1 | 02.2019 | Corn grain | Moldy grains | Refused product |
| 2 | 02.2019 | Corn grain | Moldy grains | Refused product |
| 3 | 04.2019 | Wheat grain | M = 15.1% | Refused product |
| 4 | 04.2019 | Corn grain | M = 16.3% | Refused product |
| 5 | 04.2019 | Corn grain | M = 15.3% | Refused product |
| 6 | 04.2019 | Corn grain | Moldy grains | Refused product |
| 7 | 05.2019 | Corn grain | Moldy grains | Refused product |
| 8 | 05.2019 | Corn grain | M = 15.0% | Refused product |
| 9 | 05.2019 | Corn grain | M = 15.3% | Refused product |
| 10 | 05.2019 | Corn grain | M = 15.4% | Refused product |
| 11 | 05.2019 | Wheat grain | M = 14.3% | Refused product |
| 12 | 05.2019 | Wheat grain | Impurities = 4.2% | Refused product |
| 13 | 05.2019 | Wheat grain | M = 15.2% | Refused product |
| 14 | 05.2019 | Wheat grain | M = 15.0% | Refused product |
| 15 | 06.2019 | Wheat grain | M = 15.0% | Refused product |
| 16 | 06.2019 | Corn grain | M = 14.7%; moldy grains | Refused product |
| 17 | 06.2019 | Corn grain | M = 14.7%; moldy grains | Refused product |
| 18 | 06.2019 | Corn grain | M = 15.8%; moldy grains | Refused product |
| 19 | 07.2019 | Wheat grain | M = 16.7% | Refused product |
| 20 | 07.2019 | Wheat grain | M = 15.0% | Refused product |
| 21 | 07.2019 | Corn grain | M = 14.8% | Refused product |
| 22 | 09.2019 | Wheat grain | M = 16.7 %; mold smells | Refused product |
| 23 | 09.2019 | Corn grain | M = 18.2 % | Refused product |
| 24 | 10.2019 | Corn grain | M = 18.4 % | Refused product |
| 25 | 10.2019 | Corn grain | M = 18.3 % | Refused product |
| 26 | 10.2019 | Corn grain | M = 21.2 % | Refused product |
| 27 | 11.2019 | Corn grain | Hot and burnt grains | Refused product |
| 28 | 11.2019 | Corn grain | Hot and burnt grains | Refused product |
| 29 | 12.2019 | Corn grain | Infestation with insects | Refused product |

M = moisture

The table above shows that in 2019, based on physical parameters, in the stage of receiving raw materials from unit A, 20 lots of corn grains (68.9%) and 9 lots of wheat were refused (31%). In the case of maize and wheat grains, the identified hazards were the presence of moldy, hot and burnt grains, infestation, impurities above the limit mentioned in the Grading Manual and humidity above the contractual limits.

The most commonly identified hazard (78.5%) was increased grain moisture. According to the contractual conditions established with the suppliers of raw materials, unit A imposed maximum limits on the moisture content for cereal seeds as follows: 14.5% for maize and 14% for wheat; batches of raw materials that

have recorded a higher moisture content than provided for in contract, were refused. In May most batches of raw materials (n=8) were rejected during 2019. The results of the physical hazard analyzes performed in 2020 in unit A for raw material samples were presented in Table 2. In 2020, 17 batches of raw materials were rejected, represented by corn grains (52.9%) and wheat grains (47%). The identified physical hazards were represented by the presence of foreign bodies and moldy grains, grains attacked by insects, broken grains above the limit provided in the Grading Manual and moisture above the limit established in the contract with suppliers; moisture was the predominant hazard for both corn and wheat grains (70.5%).

Table 2. Hazards identified at reception of raw materials from Unit A in 2020

| No. | Date | Product | Description of hazard | Correction |
|-----|---------|-------------|---|-----------------|
| 1 | 01.2020 | Corn grain | Foreign objects | Refused product |
| 2 | 06.2020 | Corn grain | M = 14.9%; moldy grains; infestation with insects | Refused product |
| 3 | 07.2020 | Wheat grain | M = 16.8% | Refused product |
| 4 | 07.2020 | Wheat grain | M = 15.3% | Refused product |
| 5 | 07.2020 | Wheat grain | Foreign objects | Refused product |
| 6 | 07.2020 | Wheat grain | M = 16.9% | Refused product |
| 7 | 07.2020 | Wheat grain | Foreign objects | Refused product |
| 8 | 07.2020 | Wheat grain | Foreign objects | Refused product |
| 9 | 07.2020 | Wheat grain | M = 16.2% | Refused product |
| 10 | 07.2020 | Wheat grain | M = 15.8% | Refused product |
| 11 | 08.2020 | Corn grain | Moldy grains; denaturated grains by insects | Refused product |
| 12 | 08.2020 | Corn grain | M = 17.7% | Refused product |
| 13 | 08.2020 | Corn grain | M = 15.2% | Refused product |
| 14 | 10.2020 | Corn grain | M = 21.4%; broken grains = 5.87% | Refused product |
| 15 | 11.2020 | Corn grain | M = 15.5% | Refused product |
| 16 | 12.2020 | Corn grain | M = 15.3%; broken grains = 7.22% | Refused product |
| 17 | 12.2020 | Corn grain | M = 15.3%; broken grains = 7.22% | Refused product |

M=moisture

The potentially unsafe products identified in Unit B in 2019 and 2020 are shown in Table 3 and Table 4.

In 2019, based on the physical parameters, in the stage of receiving raw materials from unit B, 22 batches of corn grains (91.6%) and two batches of wheat grains (8.3%) were refused. In the case of corn and wheat grains, the identified hazards

were the presence of sprouted, moldy and spoiled grains, infestation, and the presence of foreign bodies above the limit set out in the Grading Manual.

The most frequently identified hazard (58.3%) was the presence of sprouted and moldy grains. In January most batches of raw materials (n=12) during 2019 were refused.

Table 3. Hazards identified at reception of raw materials from Unit B in 2019

| No. | Date | Product | n | Description of hazard | Correction |
|-----|---------|-------------|---|--|-----------------|
| 1 | 01.2019 | Corn grain | 8 | Sprouted and moldy grains | Refused product |
| 2 | 01.2019 | Corn grain | 1 | Moldy grains = 0.91 % | Refused product |
| 3 | 01.2019 | Corn grain | 3 | Moldy, spoiled and sprouted grains | Refused product |
| 4 | 02.2019 | Corn grain | 1 | Spoiled grains = 0.68 % | Refused product |
| 5 | 02.2019 | Corn grain | 3 | Weevil infestation | Refused product |
| 6 | 05.2019 | Corn grain | 1 | Foreign objects above the allowed limit = 10.69 % | Refused product |
| 7 | 05.2019 | Corn grain | 1 | Foreign objects above the allowed limit = 6.07 % | Refused product |
| 8 | 05.2019 | Corn grain | 2 | Mold smells | Refused product |
| 9 | 06.2019 | Corn grain | 1 | Moldy grains | Refused product |
| 10 | 07.2019 | Corn grain | 1 | Mold smells | Refused product |
| 11 | 10.2019 | Wheat grain | 2 | Flour beetle infestation (<i>Tribolium confusum</i>) | Refused product |

n=number of batches refused

Table 4. Hazards identified at reception of raw materials from Unit B in 2020

| No. | Date | Product | n | Description of hazard | Correction |
|-----|---------|-------------|----|-------------------------------------|-----------------|
| 1 | 01.2010 | Corn grain | 12 | Weevil infestation | Refused product |
| 2 | 02.2020 | Corn grain | 1 | Sprouted and moldy grains | Refused product |
| 3 | 02.2020 | Corn grain | 8 | Bulbs with moldy and sprouted grain | Refused product |
| 4 | 02.2020 | Corn grain | 1 | Altered grains | Refused product |
| 5 | 02.2020 | Corn grain | 2 | Weevil infestation | Refused product |
| 6 | 03.2020 | Wheat grain | 4 | Weevil infestation | Refused product |
| 7 | 04.2020 | Corn grain | 5 | Flour beetle infestation | Refused product |
| 8 | 04.2020 | Corn grain | 1 | Sprouted and moldy grains | Refused product |
| 9 | 06.2020 | Wheat grain | 6 | Weevil infestation | Refused product |
| 10 | 08.2020 | Corn grain | 2 | Sprouted and moldy grains | Refused product |
| 11 | 09.2020 | Corn grain | 1 | Sprouted and moldy grains | Refused product |
| 12 | 10.2020 | Corn grain | 1 | Sprouted and moldy grains | Refused product |
| 13 | 11.2020 | Corn grain | 1 | Sprouted and moldy grains | Refused product |
| 14 | 11.2020 | Corn grain | 1 | Burnt grains | Refused product |
| 15 | 11.2020 | Corn grain | 1 | Sprouted grains | Refused product |
| 16 | 11.2020 | Corn grain | 1 | Weevil infestation | Refused product |
| 17 | 11.2020 | Wheat grain | 1 | Weevil infestation | Refused product |
| 18 | 12.2020 | Corn grain | 1 | Weevil infestation | Refused product |
| 19 | 12.2020 | Corn grain | 2 | Mold smells | Refused product |
| 20 | 12.2020 | Corn grain | 1 | M=15.9 % | Refused product |

n = number of batches refused

M = moisture

In 2020, 53 batches of raw materials were refused, represented by corn grains (79.2%) and wheat grains (20.7%); the hazards identified were infestation with various insects, the presence of moldy, burnt and spoiled grains, and moisture. The most frequently identified hazard, for both maize and wheat, was the infestation with weevils (50.9%).

It was reported that based on physical parameters in 2020 were 54.7% more refused products of raw materials represented by corn and wheat than in 2019.

CONCLUSIONS

In order to identify the hazards associated with the production of compound feed, the raw materials (maize grain and wheat grain) from two feed mills studied were analyzed and controlled during 2019 and 2020.

Regarding the hazards identified in unit A, in 2019 at the stage of receipt of raw materials, 20 batches of maize grains (68.9%) and 9 batches of wheat grains (31%) were refused, the most frequently identified hazard (78.5%) being represented by their high moisture. In 2020, 17 batches of raw materials were refused, represented by corn grains (52.9%) and wheat grains (47%); moisture was also the predominant potential hazard identified

(70.5%). In comparison, in 2019 there were more refusals of raw materials (n=29) based on physical parameters, compared to 2020 (n=17). In the case of unit B, based on the physical parameters identified in the stage of receipt of raw materials in 2019, 22 batches of maize grain (91.6%) and two batches of wheat grain (8.3%) were refused; the most frequently identified hazard (58.3%) was the presence of sprouted and moldy grains. In 2020, 53 batches of raw materials were refused, represented by corn grains (79.2%) and wheat grains (20.7%); the most frequently identified hazard was weevil infestation (50.9%). In comparison, in 2020 were 54.7% more non-compliant products refused than in 2019.

It can be concluded that in the production process of compound feed it is mandatory the physical analysis of the raw materials to determine the potential hazards; this goal is achieved in the units studied, the results highlighting the effectiveness of specific food safety control processes.

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