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Study of the incidence of the alcoholic fermentation of contaminated corn with fumonisins in the main components of the obtained vinazas

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Abstract

The balanced foods in general provide of the essential nutrients that the animal needs, be already these of animal or vegetable origin, contributing proteins, carbohydrates, fats, vitamins and minerals. It is considered foods of good nutritional quality those that satisfy these necessities in a better way, being necessary habitually to ingest of several types. However, it is necessary to consider other factors like the palatability of these, the bio-availability of their nutrients or the absence of substances that can have toxic effects for the animal organism. The toxicological quality can see affected by the commonly called anti-nutritional factors, those that are characteristics of the metabolism of the plant, or for contamination with micro-organisms that include bacterium, virus, fungi and also products of their metabolism like mycotoxins. The objective of the work was to determine the incidence of the alcoholic fermentation of polluted corn with fumonisins in the main components of the obtained products of the same one. Protein (total Nitrogen), Ash, Water, Calcium, sodium, potassium, phosphorus were studied. The components of the vinazas (residual liquid and solids obtained in the process of production of alcohol) were compared by means

of a variance Analysis and of residuals. It fits to highlight that for each analyzed parameter the adjusted prediction pattern was only and the behaviors that reflect the parameters are different therefore they should be analyzed as independent models. The essential components of the vinazas are not altered during the trial of the fermentation. Therefore after the alcoholic fermentation, it is feasible their use in the formulation of balanced food for livestock provided detoxificate is achieved by means of a later process due to the high concentration (90 %) of fumonisin B1 remainder.

Key words: ethanol, fumonisin, corn, nutrient, fermentation.

Introduction

The balanced foods in general provide of the essential nutrients that the animal needs, be already these of animal or vegetable origin, contributing proteins, carbohydrates, fats, vitamins and minerals. It is considered foods of good nutritional quality those that satisfy these necessities in a better way, being necessary habitually to ingest of several types. However, it is necessary to consider other factors like the

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palatability of these, the bio-availability of their nutrients or the absence of substances that can have toxic effects for the animal organism. The toxicological quality can see affected by the commonly called anti-nutritional factors, those that are characteristics of the metabolism of the plant, or for contamination with micro-organisms that include bacterium, virus, fungi and also products of their metabolism like mycotoxins.

The objective of the work was to determine the incidence of the alcoholic fermentation of polluted corn with fumonisins in the main components of the obtained vinazas.

Materials and methods

The corn contains around 60-75 % of starch hydrolysable to hexoses and it constitutes a high-performance source in ethanol. The corn starch contains a mixture of amilose (20-30 %) and amylopectin (70-80 %). The first one is a water soluble lineal polymer, while the second is an insoluble branched polymer in water. The scarification of the amilose is quicker than that of the amylopectin, but since the amylopectin prevails, the global conversion to fermentable sugars is governed by its degradation. Red corn was used.

The initial concentration of polluted corn naturally with FB1 was of 1,400 ppm. The dilution mixing with corn without contaminating until achieving the working concentration of 600 ppm.

The fermentation was carried out to 30 °C during 72 hours. The concentration of glucose that was used was of 135 g/l, it is the advisable one for the utilized bibliography.

For the fermentation was used a mixed cultivation of pure strains, in a relationship 1:1 previously selected of *Zymomonas mobilis* and *Saccharomyces cerevisiae*. Then liquid fraction was separated of the solid one. On this last one the following parameters were determined.

Protein (total nitrogen), Method Kjeldahl; b) Ashes, AOAC 923.03 c) Water, AOAC 8-665 d) Calcium, CAS-7440702 and Sodium, Potassium,

J. Am. Soc. Brew Chem. 36,133 f) Phosphorus, Methods of Bray-Kurtz were studied. The components of the vinazas were compared by to variance and residuals Analysis.

Results

The results composition averages of the dry vinaza coming from the alcoholic fermentation of polluted corn and without contamination are observed in the Figure 1.

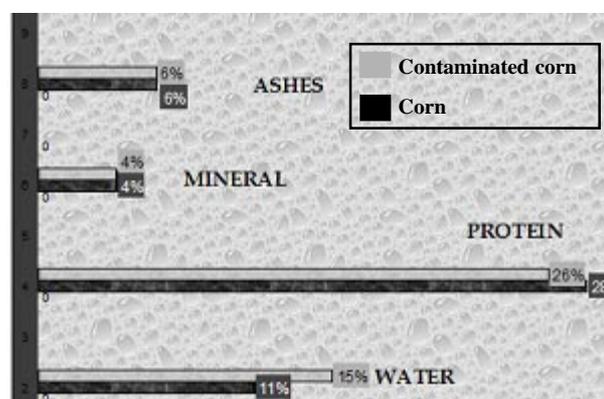


Figure 1. Vinaza dry composition obtained of alcoholic fermentation of contaminated and no contaminated corn.

Statistical analysis

The components of the vinazas were compared by a variance and residuals analysis: a) PROTEIN (Figure 2), b) ASH (Figure 3), c) WATER (Figure 4), d) MINERALS (Figure 5).

It fits to highlight that for each analysed parameter the adjusted prediction model was only and the behaviors that reflect the parameters are different, therefore they should be analyzed as independent models. Another of the suppositions of the variance Analysis is normality of the errors. It is proved that the data set and its analysis don't show anomaly.

The essential components of the vinazas are not altered during the trial of the fermentation.

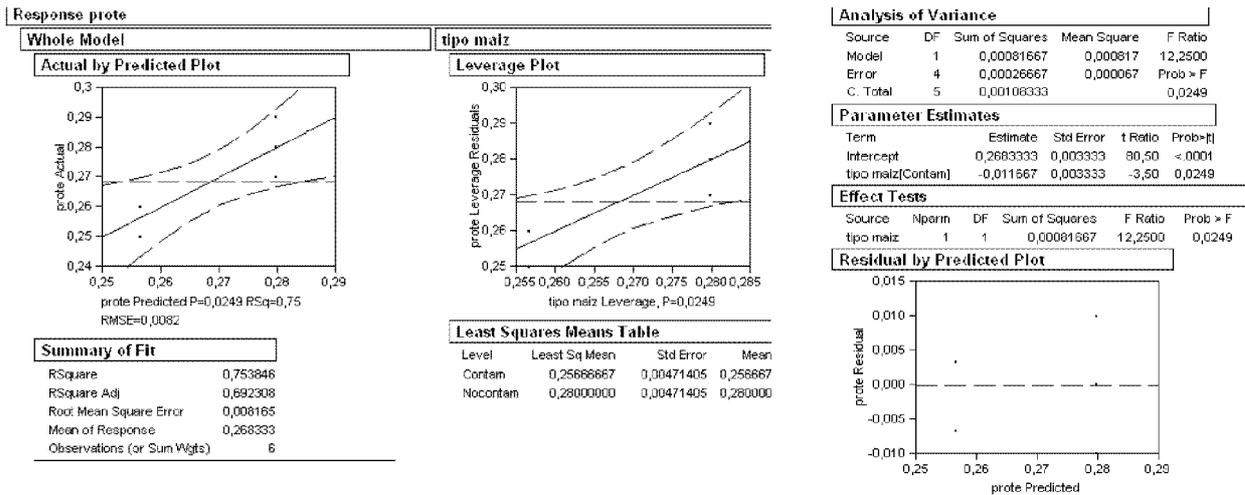


Figure 2. PROTEIN: Analysis of variance and residual predicted.

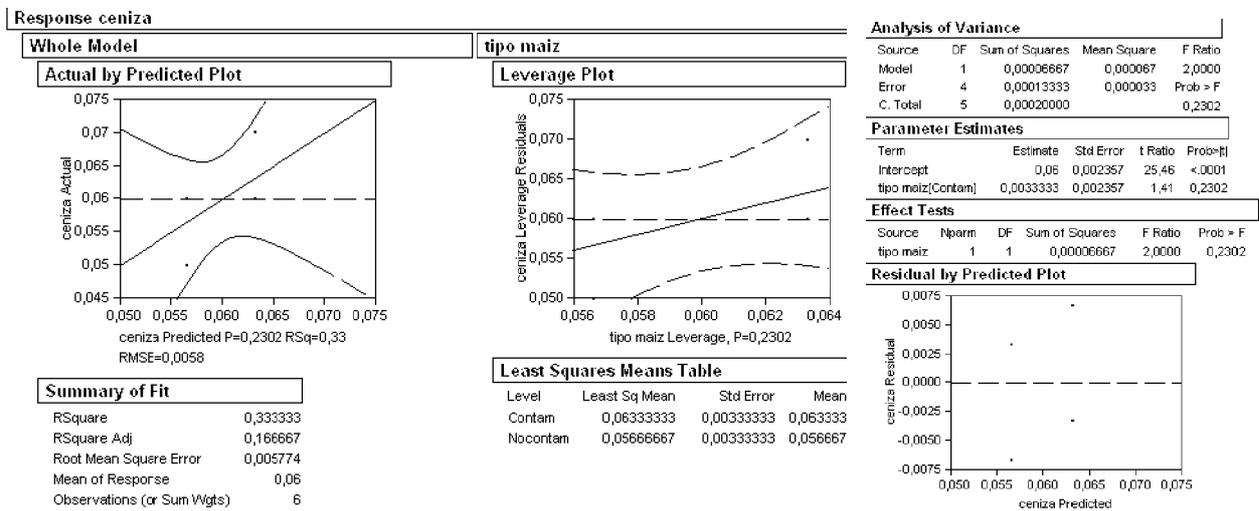


Figure 3. ASH: Analysis of variance and residual predicted.

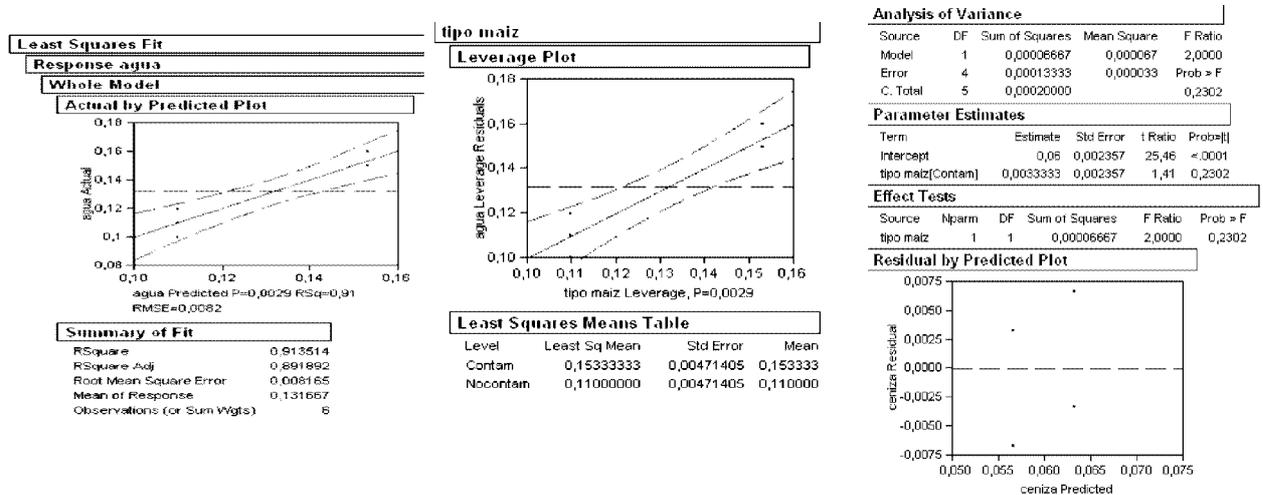


Figure 4. WATER: Analysis of variance and residual predicted.

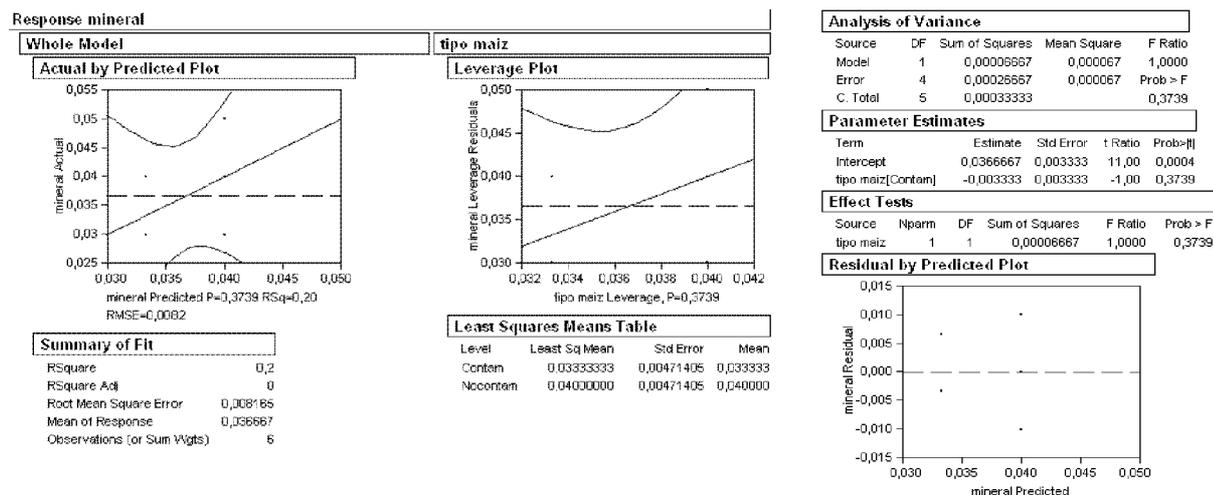


Figure 5. MINERALS Analysis of variance and residual predicted.

Discussion

The objective was to describe the main components of the vinazas coming from the alcoholic fermentation of polluted corn with fumonisins and to establish the feasibility of its use in balanced foods. As a result of the investigation it was deduced that although the main essential nutrients that the animals need were present, the opposing fumonisins were in a high concentration and therefore didn't advice their use like such.

This problem has relationship in Argentina with the system of pastoral production that with the fattening intensive methods, the use of the called portions of high energy used in animal production has created conditions that make more serious and more visible any loss caused by a toxic agent in the portions.

In our country don't exist statistics that give bill about the economic losses derived of the intoxication of the animals for the productive sector and of public health to muffle the negative effects of the contamination in the livestock.

Scott (1991) analyzed the soluble solids of the vinaza of cereals like product of fermentation finding that they possess a remarkable nutritious value for their high content in protein, nutritious salts and vitamins and apart from their utility like supplementary think for the livestock are very

appropriate to prepare means of microbiological cultivation among others. Contrary to this work, our results were carried out comparing polluted raw material of the without contaminating.

Whitlow and Hagler (2002), carried out a rehearsal in that horses were fed with diets with the help of polluted corn FB1 in a concentration between 37 and 122 ppm, observing death of animals, for that apparently, these animals are the most sensitive to FB1, being able to tolerate dose of not more than 5 ppm. In dairy livestock, pointed out that a reduction of the production of milk has seen with a polluted diet with 148 ppm of BFC 1 decrease was not observed in the gain of weight. The authors explain these null or less evident effects in bovine due to the detoxification capacity that has the rumen, being apparently more dependent of the protozoan activity than bacterial. In pigs in growth observed a smaller rate of growth (-8 with diet containing 1 ppm of FB1 and -11% with 10 ppm in the diet). Also, when polluted food is used (1 ppm) in the final period the fattening can be affected the quality of the meat (increase of the deposit of fat and smaller lean meat production).

Whitlow and Hagle (2002) concluded that in dairy cows fed with diets with the help of polluted corn with FB1 detected hepatic damage due to the biggest sources concentrations of aspartate aminotranferase and of glutei transferase.

Therefore the obtained results and that found by the aforementioned authors aren't in agreement in relation to the use of diets with high concentrations of FB1, depending this of the species in question.

The "Mycotoxin Committee of the American Association of Veterinary Laboratory Diagnosticians" recommends don't dedicate to horses, pigs, bovine livestock and birds of corral fodder with a content of FB superior to 5,000, 10,000 and 50,000 ng/g respectively (Riley, 1993; FAO/WHO, 2000; European commission 2000; FDA 2001; CAST 2003).

Conclusion

In relation to the found essential nutrients, it is feasible the use of the vinazas in the formulation of balanced foods for livestock after the alcoholic fermentation, provided detoxificate is achieved by a later process due to the high concentration (90 %) of fumonisin B1 remainder.

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