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Processing of soybean meal into concentrates and testing for Genetically Modified Organism (GMO)

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ABSTRACT

Purpose: The purpose of the paper is to show how the soybean meal is processed into the feed concentrate and how the GMO content is tested when the soybean meal is accepted in the feed concentrate factory.
Design/methodology/approach: After acceptance of the soybean meal the analysis for the protein and moisture contend is made by the use of Inframatic. The average monthly sample is sent to an external laboratory for testing for GMO content. According to the regulations the GMO content must not exceed 0,9% and is determined by the PCR (polymeraze chain reaction) method. The soybean meal is processed into the feed concentrate by the use of hammer mill, feed mixer and pellet mill. Ten analyses for GMO content have been performed by establishing the influence of the origin on the GMO content; the average percentage of GMO in the soybean meal was 0.3%.
Findings: In two cases the results of analyses of the soybean meal were negative, which means that the soybean meal did not contain any GMO; in eight cases the test was positive, but none of them exceeded the sill of 0.9%. Irrespective of the supplier or origin the average percentage of the GMO in soybean meal is approximately identical, i.e., 0.3%. Only the soybean meal, arriving from Brazil, has a smaller percentage of the GMO, i.e., 0.22%. It means that not the supplier, but only the origin has an influence on the percentage of the GMO in soybean meal.
Research limitations/implications: The research has been performed on soybean meal, arriving from Brazil and Hungary, where ten analyses for GMO content have been performed.
Practical implications: On the average, the soybean meal coming from Hungary contains more GMO, i.e., 0,3%, than the soybean meal coming from Brazil, which contains 0.22%.
Originality/value: The research showed that most soybean meal were genetically modified, but in no case the limit prescribed by the regulations, i.e., 0.9%, was exceeded.
Keywords: Technological devices and equipment; Soybean meal; Pellet mill; Hammer mill

1. Introduction

The soybean meal is a highly nutritive product produced by processing high-quality peeled soybean grains. It is the most important source of proteins, minerals and vitamins in feeding domestic animals. Worldwide, particularly in the U.S.A as the leading producer of the soybean, most of soybean has already been genetically modified [1]. Genetically modified organism (GMO) is an organism with modified genom to which a new gene has been added. The gene is capable to express an additional protein giving certain new properties, such as tolerating the herbicides or resistance to viruses, antibiotics and insects. At first glance, the resistance to pests, herbicides and illnesses is a very attractive promise, but it does not consider possible harmful effects on the environment and health of humans and does not give overall and correct information about the results of use of GMO [2]. Many countries have prepared the legislation for the use of GMO. In the

European Union marking is obligatory for products containing genetically modified maize (Bt maize from Novartis) and for the soybean (RR – soybean from Monsanto), when the percentage of genetically modified organisms is higher than 1% [3, 4, 5, 6].

2. Processing of soybean meal into the feed concentrate

After receiving the soybean meal in the feed concentrate factory the former is conveyed into the silo from which it is conveyed by a conveying line to the mill where it is ground with the use of a proper sieve. All the functions performed are controlled from the central computer in the control desk.

When the meal has been ground, it is conveyed to the mixer, where it is mixed in suitable ratio with other components required for the feed concentrate. The factory has available a mixer of two ton capacity. After completion of mixing the feed concentrate travels into the silo. If the feed concentrate is in the mealy condition, it is transported to the final user. Otherwise it must be pelleted into pellets of proper dimension suitable for the individual kind of animal. After pelleting the pellets travel into the cooler in order to cool, since during the process of fabrication the pellets are exposed to hight temperatures and the process of deterioration would start, if the pellets were conveyed non – cooled into the silo [7, 8].

In the end the pellets go into the silo from which they are transported by a tank truck to the final user. For smaller consumers of feed concentrates the feed is bagged up by a robot which labels the bag by a label and stacks the bags onto pallets. The label contains all the data ensuring traceability of the feed concentrate including the statement whether the feed contains the GMO or not.

2.1. Hammer mill

For adequate preparation of the feed concentrate the factory is equipped with two hammer mills (Figure 1). Champion hammer mills are designed for the most demanding operations. These rugged, high-efficiency hammer mills are capable of fine-grinding either friable or fibrous materials. Champion HM Hammer mill has Double wall box construction, mechanical steel tube base, double row spherical roller bearings, full access doors, bidirectional inlets, patented regrind chamber, abrasion-resistant wear liners and it requires 75-150 hp motor. Capacity of the individual mill is 10 ton/hour and depends on the type of raw material and size of grinding. When the raw material is used for the manufacture of pellets it must be ground more finely, for example the soybean meal with 6 mm sieve, for better preservation of pellets.

Fig. 1. Hammer mill [9]

2.2. Pellet mill

The process of pelleting consists of forcing soft feed through holes in a metal die plate to form compacted pellets which are then cut to a pre-determined size. The machinery (Figure 2) which has been developed for this purpose is now very diverse in design and there is much controversy between different equipment manufacturers as to which type is the most effective. Pelleting is a key to the production of high quality nutrional feeds as they ensure that the feed formulation is in the correct quantities for all that eat them. Each bite of the pellet will have the same designed formulation ensuring all the stock are fed as intended. A very important component of the pellet mill is the die (Figure 3). Pellet dies must resist abrasion, corrosion from chemical exposure and breakage caused by the physical stresses of pellet formation. The optimum die combines high resistance to abrasion, breakage and corrosion with maximum productivity. Dies are from different materials and so we have three different types of dies. Alloy dies are the choice for many feed processors because of their good abrasion and breakage resistance. Chrome dies have superior corrosion resistance, making them the choice for processing operations involving corrosive chemicals. Carburized stainless dies have the best abrasion and breakage resistance as well as good corrosion resistance. They have a different size of dies and they are available to make pellets to precisely match different formulations.

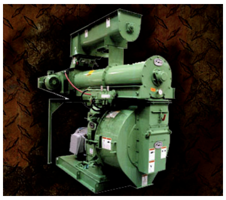

Fig. 2. Pellet mill (CPM) [9]

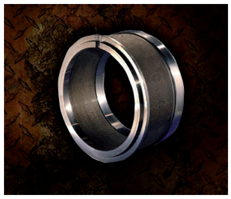

Fig. 3. Die [9]

2.3. Cooler and dryer

Pellets from dry pelleters may exit at up to 88°C and 17-18% moisture. The temperature must be quickly reduced to ambient or less and the moisture level to 10-12% or less for proper storage and handling. Pellets must therefore be cooled and dried. Moist pellets, if they are going to be converted to dry pellets, also need drying although their temperature is not normally much elevated during manufacture. Coolers/dryers are of two basic types, horizontal and vertical.(Figure 4). CPM coolers come in a variety of widths and lengths to match cooling needs. In factory they have a CPM series HC Horizontal cooler, which is able to cool and dry up to a 16" bed of pellets. It has a large holding capacity increased residence time and efficiency and Air volume requirements may be as low as 600 SCFM per ton per hour in some applications [9, 10].

Fig. 4. Cooler and dryer [10]

3. Materials and methods

3.1. Checking of soybean from growing to processing

Most genetically soybean is produced in the U.S.A and in Brazil from where the ships transport it to the individual countries where it is processed into the soybean meal usable as one of the important components in feeding domestic animals and providing particulary, the raw proteins. According to the legislation, the soybean must not contain more than 0,9% of GMO [11, 12]. Table 1 shows the checking of soybean from growing to processing [13].

Table 1.
Checking of soybean from growing to processing [13]

Brazil
Where – safe areas of growing
What – growing of soybean grains
To what place - transport by trucks into separate store rooms
1. PCR Test – Silo
What – store room for selected Wiesenhof soybean – transport by rail through Brazil
To what place and who – oil milles
What – separate store room and soybean processing
2. PCR Test
Germany
Where – processing
What – separate storage – silo – transport through Germany (trucks, trains)
Inspection where – own feed mixing plants
3. PCR Test
What – despatch of animal feed with genetically modified soybean to breeders.

Since growing of soybean till processing into the soybean meal and other components the soybean is checked for genetically modified organisms with PCR (polymeraze chain reaction) method. Checking is effected in silo, store rooms and in transit.

3.2. Sampling of soybean meal

The soybean meal was sampled in the same way as the cereals and identical devices and means were used. The sample represented the average composition of the entire quantity of the product from which the sample was taken. It was taken in such a way that each unit of the product had the same chance to be selected. The sample for the analysis of raw materials is the sample obtainted by reducing the total sample and is used for the laboratory analysis. The organoleptic test of the soybean on the transport vehicle is important for the first evaluation of the colour – gloss, odour, health and deterioration or moulding of goods due to the truck or rail wagon roof leakage. Next, the most important part of analysis is effected, namely sampling, since a non – representative sample cannot ensure a realistic estimate and/or analysis of the soybean meal [13, 14, 15].

3.3. Analyzing of soybean meal

Two suppliers (Agrokor ond Agrograin) from Hungary and Brazil imported the soybean meal 46% (46% of proteins in soybean meal). In total, 14.820.200 kg of soybean meal arrived in 2005 (Table 2).

Table 2.
The soybean meal (46%) arriving into the feed concentrate factory in 2005, supplied by supplier, date by date of sampling [13]

Supplier	Weight (kg)	Date of sampling
Agrokor – Brazil	1.630.200	3.1. – 30.1. 2005
Agrokor –Brazil	1.300.400	2.2. – 27.2. 2005
Agrograin- Hungary	1.140.600	3.3. – 29.3. 2005
Agrograin- Hungary	1.210.300	2.4. – 28.4. 2005
Agrograin- Brazil	980.300	6.6.- 28.7. 2005
Agrograin- Hungary	1.170.400	12.6. – 30.7. 2005
Agrograin- Hungary	1.380.200	10.8. – 28.8. 2005
Agrograin- Hungary	1.050.200	5.9. – 29.9. 2005
Agrokor – Brazil	1.505.300	4.11. – 30.11. 2005
Agrokor – Brazil	1.602.600	3.12. – 21.12.2005

4. Results with discussion

4.1. Results of analysis of soybean meal

The analysis for the presence of GMO in the soybean meal was performed by the National institute for biology in Ljubljana (Table 3).

Table 3.
Results of analysis of soybean meal (46%), quantities supplied and deviations with respect to origin and supplier of the soybean meal [13]

Origin	Supplier	Result (%)	Deviations (%)	Weight (t)
Brazil	Agrokor	0,24	0,12	1.602
Brazil	Agrokor	0,34	0,14	1.505
Hungary	Agrograin	0,64	0,06	1.050
Hungary	Agrograin	>0,1	0	1.380
Hungary	Agrograin	0,42	0,18	1.170
Brazil	Agrograin	0	0	980
Hungary	Agrograin	0,46	0,08	1.210
Hungary	Agrograin	0,42	0,12	1.140
Hungary	Agrokor	0,32	0,08	1.300
Brazil	Agrokor	0,28	0,14	1.630

On the average, the percentage of GMO in the soybean meal is identical irrespective of the fact by whom and from where it was supplied. Only inside the supplier Agrograin of Hungarian origin a slightly greater standard deviation appears involving that the GMO content in the soybean meal is not equalized (Figure 5).

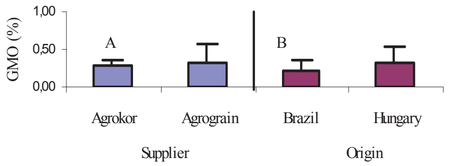

Fig.5. Average values of GMO in soybean meal and standard deviation with respect to supplier and origin [13]

In case of soybean meal supplied by Agrokor and soybean meal arriving from Brazil the deviations are equal. In case of Agrograin and Hungarian origin the deviations are slightly higher and the relevant standard deviation is slightly higher (Figure 6).

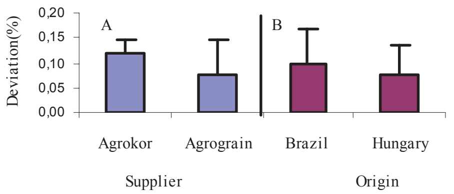

Fig. 6. Average values of deviations and the standard deviation with respect to supplier and origin [13]

Most soybean meal had been supplied by Agrokor and most of it is of Brazilian origin. Average quantities of the soybean meal arriving into the feed concentrate factory with respect to the supplier and origin, are shown (Figure 7).

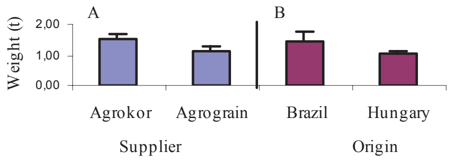

Fig 7. Average quantities of soybean meal in tons and standard deviation with respect to supplier and origin [13]

There are no statistical differences between the origin and GMO, deviation, quantity, since $P>0,05$.

The experimental work was performed in the mixing plant of the Poultry breeding company in Ptuj where feed concentrates are mixed for chickens. The average monthly sample was send to the biological institute in Ljubljana where analysis for the presence of the GMO in raw materials and their products are performed. As such analyses are expensive, ten analyses for the presence of the GMO in the soybean meal were performed in year 2005. In eight cases the result was positive, however, in no case it exceeded the value allowed by the rules and regulations.

5. Conclusions

According to legal rules and regulations the product, i.e., the soybean meal may contain up to 0,9% of GMO. The results of analysis of the soybean meal, performed by the national laboratory in Ljubljana, were negative in two cases; it means that the soybean meal did not contain any GMO. In eight cases the test was positive, but none of them exceeded the 0,9% sill.

Ten analyses for the presence of the GMO in the soybean meal (46%) were performed. Irrespective of the supplier or origin the average percentage of GMO in the soybean meal is approximately the same, i.e., 0,3%. Only the soybean meal arriving from Brazil had the lowest percentage of GMO, i.e., 0,22%. It means that not the supplier but only the origin have an influence on the percentage of GMO in the soybean meal.

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