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Methods of Protein Raw Materials Falsification Defining.

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ABSTRACT

The problem of high-protein feeds falsification is still acute for farm animal feeds market. The article describes some examples of falsification and ways of its detection. In the Russian Federation a high-protein counterfeit products began to appear with the most simple but the most dangerous for farm animals feeds, where cereal components were mixed with salts containing nitrogen. Then there were the counterfeits of fishmeal containing syntactical amino acids – lysine, methionine and threonine and soybeans or soybean by-products. Nowadays there is a new protein component of feed on the market containing about 85% of crude protein, due to the lack of fat and carbohydrates, but the amino acid composition of such a feed contains incredibly large number of glycine and proline. It is noteworthy that this high protein product is sold at a very low price, thus attracting the consumer. Feeding monogastric animals with falsificated protein raw material causes not only metabolic disorders and reduce productivity, but may lead to starvation or even deaths. The article presents some ways of counterfeit high-protein feeds detection that have been tested in the laboratory of feed and metabolism of the Stavropol State Agrarian University.

Keywords: protein, feed

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INTRODUCTION

High-protein raw materials are the critical component in the diet of farm animals. Its use in animal feeding allows to increase the intensity of growth as well as resistance in infectious diseases; to improve fertility; to reduce the use of medicines; to decrease the fat content in the meat.

High quality fish meal contains up to 74% of protein and as for essential amino acids - lysine, methionine, cysteine, threonine and tryptophan this product is one of the most valuable. In animal feeding the proportion of fish meal is 2-10% [5].

On the domestic market, unfortunately, there are unscrupulous companies that export high-quality fishmeal from Mauritania, Morocco, Iceland and some other countries and then mix it with some useless and harmful product [1, 12]. Not only fishmeal, but other high-protein raw materials are subjected such a fraud.

Unlike Russian market, the European Union has banned the use of feeds of animal origin for farm animal diet as well as use of horse meat and other non-traditional raw materials in the production of sausage goods for people. [7, 9, 11].

MATERIALS AND METHODS

Recently different methods of identifying non-tradition raw materials in feed mixtures have been designed [6, 8, 10]. The laboratory "Feeds and metabolism" of the Stavropol State Agrarian University also has succeeded in developing of the identification methodology of different falsifications of high-protein products. The methodology is based on crude protein and amino acid composition produced by incorporating in the raw material some synthetic amino acids, feather powder, salts containing nitrogen, and a new component that contains a large number of the glycine amino acid.

RESULTS AND DISCUSSION

After analyzing a sample of a high-protein feed in the laboratory (Table 1), we can conclude that the basis of this protein-vitamin-mineral concentrate is a real fish meal, as stated by the manufacturer.

Table 1: Amino acid composition of the analyzed feed

Indicator, %	Fish meal	Test results
Aspartic acid (Asp), %	-	4,53
Threonine(Thr), %	2,97	1,77
Serine(Ser), %	-	2,14
Glutamin acid(Glu), %	-	8,44
Proline(Pro), %	-	1,89
Glycine(Gly), %	-	2,29
Alanine(Ala), %	-	2,21
Valine(Val), %	-	2,03
Methionine (Met), %	1,99	1,92
Isoleucine(lie), %	-	1,82
Leucine(Leu), %	-	3,19
Tyrosine(Tyr), %	-	1,38
Phenylalanine(Phe), %	-	1,98
Histidine(His), %	-	1,53
Lysine(Lys), %	5,42	5,68
Arginine Arginine(Arg), %	4,12	2,90
Cystine (Cys), %	0,66	0,50

According to the content of lysine and methionine and due the distinctive smell we came to the conclusion that the basis of this product is high-quality fish meal. According to the number of limited essential

amino acids, we may judge about natural origin of the fish meal sample, as their contents were the most stable. At the same time some synthetic methionine – 1.52 % and synthetic lysine - 2,87 % were identified in the tasted sample. However, the difference between the total number of the amino acids in the sample and synthetic amino acids allows to think that the basis of this product is some soybean product, containing 0.40% of methionine and 2,80% of lysine, but not fish meal. So the manufacturer, having the high accuracy equipment, falsified lysine and methionine in his product, making them as similar quantity as in natural fish meal. Without identifying synthetic amino acid in their total amount, it is impossible to reveal the falsification.

The experience of Russian poultry farmers shows that fish meal analogues falsified in their amino acid composition with synthetic amino acids give the worst result in the young growth of agricultural animals breeding in comparison with the use of natural fish meal, and this effect may be explained by the amino acids availability. The problem of the amino acids availability in fish meal analogues is studied not enough, so the farmers may only rely on manufacturer’s honesty while buying the fish meal [4, 13]. If we research this issue from the point of view of nutrition physiology, negative effect may be explained by the fact, that synthetic amino acids that are in their free state in a feed, are absorbed by blood far more faster than amino acids contained in protein molecule [2, 14]. Amino acids from a molecule come first to the intestine that is why they are absorbed by blood later and are used in building of an animal’s protein molecule. Thus, while protein is being split in the intestine, an abundance of synthetic amino acids is circulating in the blood and the liver starts to remove them as excessive. This fact is explained by the Leibig’s law of the minimum – an organism digests the protein from the feed according to the limited amino acid and synthesizes specific protein molecule of animal origin. [3, 15].

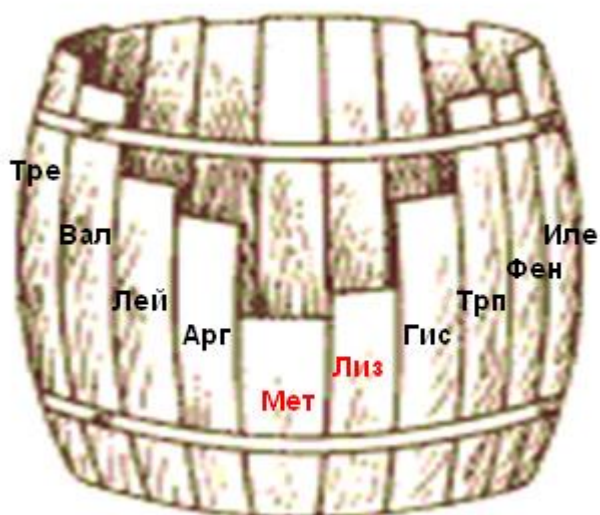


Figure 1: Liebig’s barrel

Figure 1 – Liebig’s barrel explains the process of amino acids pool digestion according to the limited amino acid, that is, how much water would be added to a barrel with the different height of planks, the level of water would be equal the shortest of the planks.

The positive point of the feed we have analyzed is that the manufacturer honestly didn’t call his product “fish meal”. We know that some unscrupulous businessmen present their counterfeit as a natural fish meal. Moreover, amino acid composition on limiting amino acids corresponds to the first-grade fish meal. Not all the laboratories have the opportunity to define the total amount of the amino acids and the content of synthetic amino acids in this amount. Besides, it takes twice more time and money.

There are counterfeits with non-protein nitrogen as well. Such counterfeits are clearly defined because of high ammonia peak in aminograms (Fig. 2). The highest peak in the aminogram is ammonia and all the others peaks look small, while all of them should be quite the same height as ammonia. The sample which aminogram is presented in Picture 2 turned out to be counterfeit non-protein nitrogen. It contains 62% of

crude protein and about 18% of protein the difference turned out to be non-protein nitrogen. If a monogastric animal is provided with such a feed it may result not only in productivity reduce but may have negative influence on animal's health.

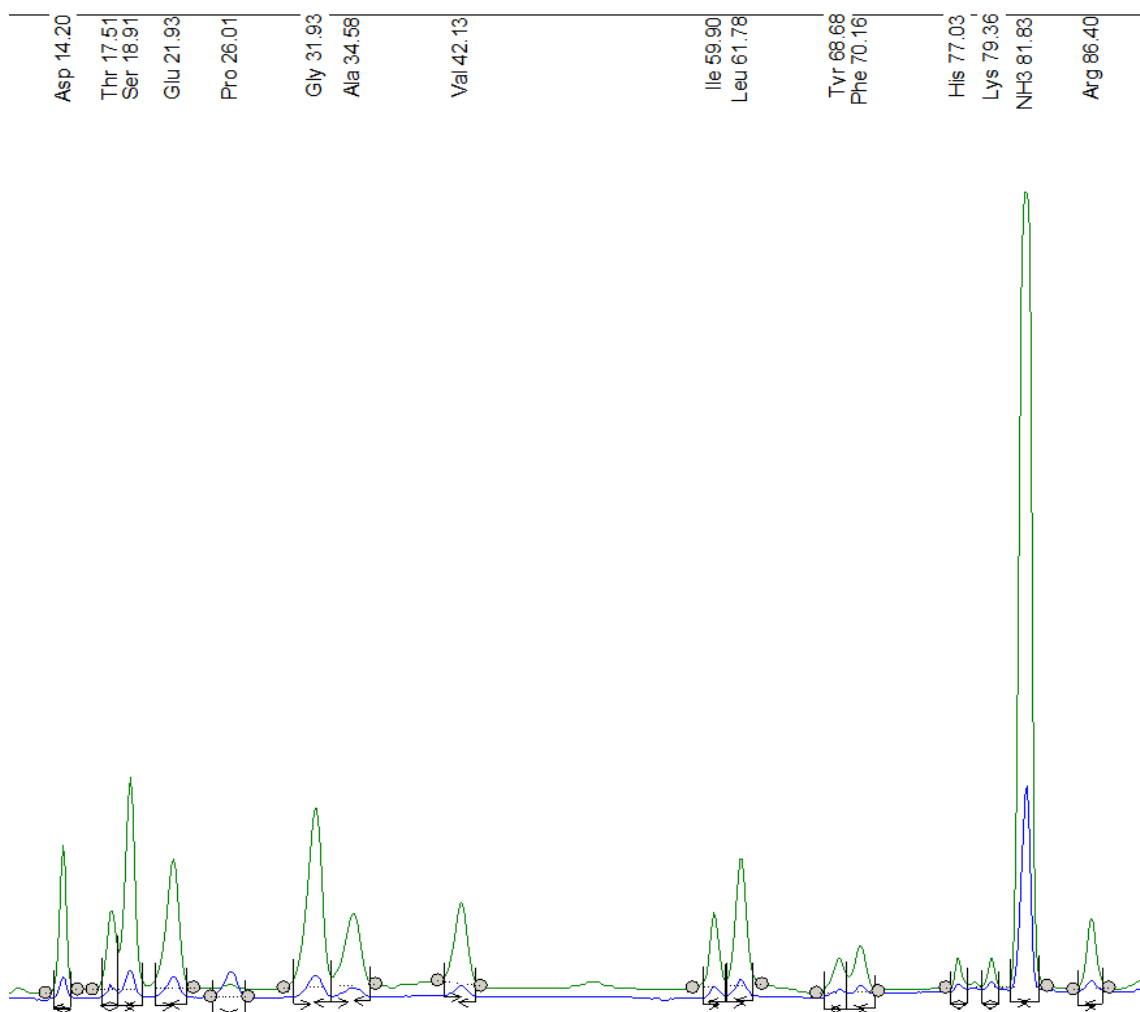


Figure 2: Aminogram of counterfeit fishmeal with non-protein nitrogen

The most common fraud is substitution of fish meal with feather meal because the latter contains much crude protein and doesn't contain non-protein nitrogen. On the basis of feather meal and soybean products it is possible to make mixtures due the high-protein contain in feather (more than 80%) and it is easy to rise crude protein level up to 60-65%. In this case there is no negative influence on animal's health, but no productivity as well. This counterfeit is very easy to test by the ratio of sulfur-containing amino acids, such as cystine and methionine.

A feather contains 4 times more cystine than methionine and fishmeal contain 2 times more methionine than cystine. Figure 3 shows cystine peak is higher than methionine peak that means the large number of feather in feed.

Table 2 presents comparative content of amino acids in natural fish meal, meat meal and feather powder we have analyzed for our research. All the methods of protein feeds counterfeit mentioned above are well known to unscrupulous producers and they are constantly inventing frauds of high-protein raw materials.

Table 2: Quality indicators of high-protein raw materials

Indicator	Fish meal	Meatmeal	Feathermeal
Aspartic acid (Asp),%	5,35	5,35	5,10
Threonine(Thr), %	2,73	2,63	3,57
Serine (Ser), %	2,65	2,3	8,50
Glutamic acid (Glu),%	7,98	8,69	7,98
Proline (Pro), %	3,2	2,74	9,38
Glycine (Gly), %	4,07	2,66	5,77
Alanine (Ala), %	3,57	3,32	3,92
Valine (Val), %	2,93	2,7	5,14
Methionine (Met), %	1,81	1,55	048
Isoleucine (Ile), %	2,44	2,41	3,42
Leucine(Leu), %	4,37	4,42	6,11
Tyrosine(Tyr), %	2,12	1,91	2,25
Phenylalanine(Phe), %	2,58	2,29	3,71
Histidine(His), %	1,97	2,61	0,67
Lysine(Lys), %	4,61	4,26	1,68
Arginine(Arg), %	4,67	4,23	6,04
Cystine (Cys), %	0,48	0,45	2,55
Crude protein, %	62,37	55,13	73,84
Crude fat, %	12,08	31,75	4,58

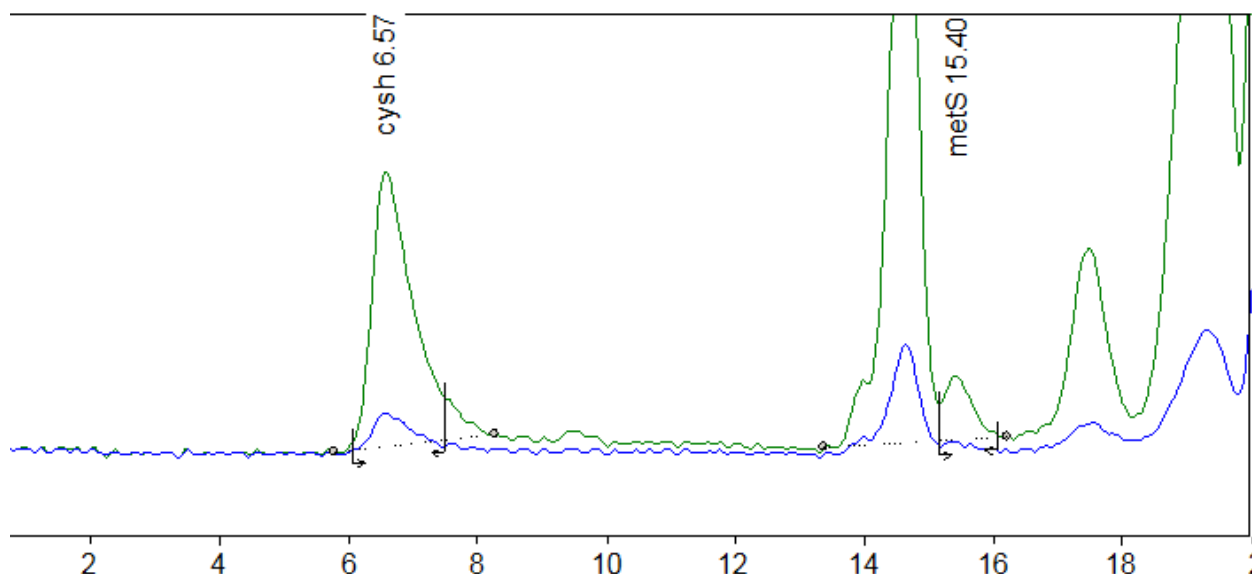


Figure 3: Aminogram of sulfur-containing amino acids in counterfeit fishmeal.

One of them we meet quite often. It comes to our market in the form of first-quality meat meal and protein concentrate. This product is interesting for us because it contains a large amount of crude protein - about 85%, non-protein nitrogen and toxic level in the product is in norm that means a natural origin of the protein but crude fat in the product is absent completely. The test in the laboratory showed the absence of feather, because the content of cysteine was – 0,09%, and methionine content 0,61%. The first opinion was that we have found an excellent sample of natural high-protein raw material but we paid the attention on the glycine content in the sample - about 20% from the total amount of the amino acids that is not common for natural-origin feed protein. Synthetic amino acids were not found in the sample, so it is still unclear why glycine content is so high. (Fig. 4).

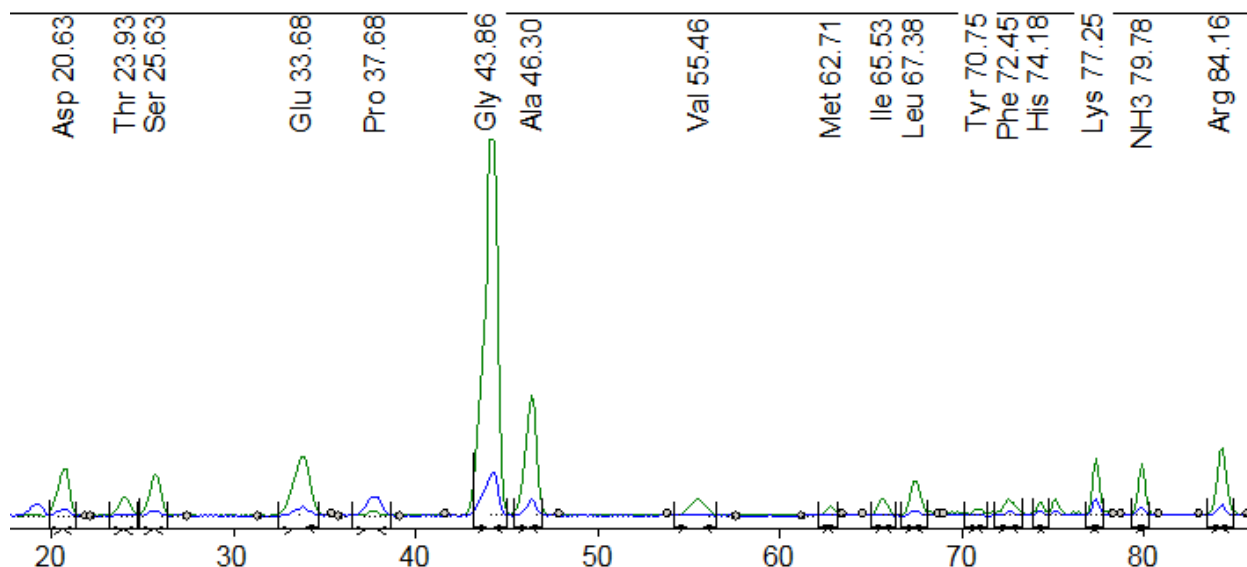


Figure 4: Aminogram of counterfeit meat meal with 20% glycine content

Aminogram clearly shows high glycine peak, alanine and proline peaks are high as well if we compare them to another amino acids. Left to aspartic acid peak one may see peak of some unknown to us substance. There is no such a peak in the aminogram of feed protein hydrolysates that means unknown for today protein raw material counterfeit. After the acid hydrolysis process we had clear greenish liquid without any precipitate, that also indicates unnatural origin of the feed.

On the animal farms where tested “meat meal” was fed to animals the following negative effects were noted: productivity decrease, diarrhea, emaciation and even loss of cattle.

CONCLUSION

Analyzing the fact given above we may conclude:

- In the present-day situation it is necessary to check carefully all the high-protein feeds because such feeds are rather expensive product on the feed market. Purchase of counterfeit protein feed may result not only in loss of money, but loss of cattle as well.
- Fish meal identity may be defined by the quantity ratio between cysteine and methionine if it is falsified by feather meal.
- Protein products should be subjected to obligatory check on non-protein nitrogen content. Falsification of these products and their feeding to farm animals have negative effect on monogastric animals’ health and productivity.

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