Problems of unification of fodder quality and nutritive value assessment systems

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Abstract. The article is devoted to the urgent need for improvement and unification of systems for the quality evaluation of feed and rations. Lack of uniform sampling methods, analysis methods, feed quality indicators; norms of the nutrient requirements depending on the physiological state of animals, a unified approach to balancing diets, and most importantly - the absence of an international standard system for assessing the energy nutritive value of feed and rations - complicates the mutual understanding of scientists and practitioners from different countries and the integration of scientific achievements into agricultural production.

The scheme of chemical analysis of feed, developed in 1860 by V. Genneberg and F. Schtomann (Veende, Holland), is used in our country almost unchanged to the present time. Breakthrough innovations in the field of assessing the nutritive value of feed and rations were noted in the late 19th and early 20th centuries. The disunity in research has led to the creation of many national systems for evaluating the quality of feed, which are very different from each other. Discussions about the advantages and disadvantages of certain systems have arisen quite often many years after their implementation. Thus, the comprehensive system for evaluating feeds in the GDR [1] replaced the classical system of "starch equivalents" by O. Kellner in 1971, after half a century of its widespread use. It was found that, according to the system of starch equivalents, roughage as a source of energy was greatly underestimated (hay - on average by 20%, straw - by 80%), and concentrates were overestimated (on average by 10%) [2]. Thus, in most countries that used the starch equivalent or oat feed unit system, the underestimation of coarse and overestimation of concentrated feed was practiced for a long time, which caused significant economic damage to farms. Therefore, the system for evaluating the quality of feed and rations is not only a zootechnical category, but also an economic one.

Currently, there are many ways to determine the energy nutritive value of feed, which complicates the mutual understanding of scientists and practitioners from different countries and the integration of scientific achievements into agricultural production.

German scientists [3] conducted a comparative analysis of several variants of the most common systems: 1. starch equivalents - SE; 2. energy feed units - EF (Rostok, GDR); 3. metabolizable energy - ME (England); 4. net energy for lactation - NElact (Holland); 5. net energy for lactation - NElact - (France); 6. net energy for lactation NElact - (Germany); 7. net energy for maintenance – NEmaint (USA); 8. net energy for pregnancy – NEpregn (USA); 9. net energy for lactation - NElact (USA). As a standard for comparing feeds and systems, the authors took the energy value of 1 kg of barley, namely, according
to the system variants: 1. 817 SE; 2. 2.695 EF; 3. 13.37 MJ ME; 4. 16.26 Kcal NE_{lact}; 5. 148 Mcal NE_{lact}; 6. 8.55 MJ NE_{lact}; 7. 196 Mcal NE_{main}; 8. 1.31 Mcal NE_{pregn}; 9. 191 Mcal NE_{lact}.

Table 1 shows the energy value of some bulky forages in relation to the energy of the reference forage (as a percentage of barley energy value).

| Fodder                  | System variants |
|-------------------------|-----------------|
| Grasses, before flowering | 85.7 92.2 87.7 91.1 89.0 84.0 86.7 82.4 89.0 |
| Grasses, after flowering | 70.4 81.0 75.3 73.9 73.6 70.2 67.8 55.7 73.3 |
| Grass silage             | 73.3 84.7 77.6 73.6 76.5 73.8 70.4 63.3 73.2 |
| Prewilted grass silage   | 69.0 84.0 77.7 75.0 76.0 73.3 67.8 55.7 68.1 |
| Grass hay                | 61.3 78.6 73.7 71.7 73.3 68.7 62.8 45.0 68.1 |
| Corn silage              | 72.7 82.3 77.0 76.2 71.9 72.2 71.9 62.6 77.0 |
| Wheat straw              | 17.5 48.5 45.2 39.4 37.9 56.4 50.5 7.6 52.9 |
| Fodder beets             | 77.6 97.8 99.7 96.3 84.1 98.1 91.8 91.6 93.7 |
| Average                  | 66.0 81.1 76.7 74.7 72.8 74.6 71.2 58.3 74.4 |

Comparison of the data presented in Table 1 indicates a significant difference between the systems for assessing the energy nutritive value of feed. For greater clarity, in the last row of Table 1, the arithmetic mean of the values of the relative values of all eight feeds is given and graphically presented in Fig. 1.

Figure 1. Relative energy value on average for a group of feeds when evaluated by different systems.

The greatest deviation is noted for the systems: 1. starch equivalent (and, consequently, oat feed unit); 2. energy feed units (Rostok, GDR); 8. net energy for pregnancy (USA). The relative energy value for the rest of the systems also fluctuates within significant limits (71.2...76.7%). It is obvious that the standardization and unification of the system for assessing the energy value of feed is an urgent problem of international importance. Therefore, the development and circular testing of a unified method for determining the energy value of feed is possible only under the aegis of a generally recognized arbiter - the International Organization for Standardization (ISO).
The unification of the method for determining the energy value of feed is associated with the standardization of many related procedures: methods of sampling feed, methods of their analysis, selection of indicators of the quality of feeds and rations.

An objective assessment of the quality and nutritional value of feed depends on the correct sampling in the places of their storage. Most of the sampling instructions are contradictory both in the number of primary samples, and in location of sampling places.

In the 80s of the last century, the V.R. Williams Research Institute of Feed and the Central Institute of Agrochemical Services for Agriculture carried out fundamental research on the development of standardized methods for sampling bulk feed, which culminated in the publication of GOST 27262-87 Vegetable feeds. Sampling methods.

At the beginning of the XXI century, Russian standards were revised with the requirement of their maximum harmonization with the international ISO standards. All branch standards, enterprise standards and many GOSTs were disavowed. In accordance with the order of Rosstandart dated November 23, 2011 N 587-st, the application of GOST 27262-87 “Vegetable feeds. Sampling methods” [4] on the territory of the Russian Federation was canceled on January 1, 2013 and GOST R ISO 6497-2011 “Animal feed. Sampling” [5] was introduced.

Since the ISO 6497 standard established sampling feeds of industrial preparation (with the exception of alfalfa grass meal), agricultural production in Russia was thoughtlessly deprived of a standard for sampling bulk feed. And only after a long-term agreement, the legitimacy of GOST 27262-87 “Vegetable feeds. Sampling methods” was restored without limitation of validity period (protocol N 7-95 of the Interstate Council for Standardization, Metrology and Certification). This once again emphasizes that it is impossible to blindly adopt the documents of even such a recognized organization as ISO, but it is necessary to adapt them taking into account national developments.

The high level of ISO standards requires high qualifications and analytical discipline from users. So, if the definition of the caloric content of feed, set out in the methodological manual "Zootechnical analysis of feed" [6], is available to students and graduate students, then for the development of the interstate standard GOST ISO 9831: 1998 "Animal feeding stuffs, animal products, and faeces or urine - Determination of gross calorific value - Bomb calorimeter method" [7] requires the basis of mathematical and physical knowledge.

The complication of the system often leads to its denial. Thus, the refined and carefully developed complex system for evaluating feeds of the GDR [1] did not find application in the united FRG. In the same way, the progressive technology of application of variable norms of the requirements of cattle in dry matter, metabolizable energy, crude and digestible protein at different levels of productivity and quality of feed has not received recognition in Russia [8].

The traditional striving for rationalization and simplification of feed analysis methods ultimately leads to inaccurate research. So, in order to save money and time from GOST 13496.2-91 “Fodders, mixed fodders and mixed fodder raw material. Method for determination of raw cellular tissue" removed the final crude fiber ashing procedure. As a result of this “rationalization”, the level of crude fiber in feed unjustifiably increased by 0.5-2.0%, which led to erroneous calculations of the nutritive value of feed and an imbalance in rations. And only in 2009 the development of GOST R 52837 “Feeds. Methods for determination of crude fiber content with intermediate filtration” [9] has eliminated this drawback.

Despite the high level of organization of efforts in the development of international standards, the possibilities of ISO are not limitless. Thus, an attempt to standardize the method for determining the digestibility of organic matter in vitro ended unsuccessfully. Circular tests in laboratories in different countries have shown the inadequacy of procedures, equipment, and analyst qualifications. As a result, the finances, time, and energy of ISO employees were wasted without visible benefit.

Discussions about the advantages and disadvantages of feed quality evaluation systems are ongoing and will continue. Only one thing is indisputable: the most reliable way is to determine the feed efficiency by the end result - the production of livestock products. However, the optimal end result can only be obtained on the basis of scientific knowledge. It is no coincidence that in many countries with developed dairy farming, intensive research is being carried out to study metabolism in animals,
nutritional norms are periodically updated, new indicators are introduced, and on this basis approaches to assessing the nutritive value of feed and rations are adjusted [10].

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