RESULTS OF THE NUTRITIONAL PRESERVATION RESEARCH OF THE ALFALFA LAYING ON STORAGE WITH TWO-PHASE COMPACTION

Методи і отримані результати можуть бути використані в розробках конструкторських бюро для створення нової техніки заснованої на двохстадійному ущільненні рослинних компонентів кормових сумішей при заготівлі їх до зберігання.

Keywords: coefficients of nutrients preservation, procurement of fodder, storing of alfalfa, cost of fodder procurement.

Abbreviations: CP.CFi – crude fibre preservation coefficient; CP.CP – crude protein preservation coefficient; CP.NFE – nitrogen-free extracts preservation coefficient; CP.CF – crude fat preservation coefficient.

ABSTRACT
In modern manufacturing of livestock production, the outstanding value is allocated for a food supply. The main criterion for evaluating the quality of feed components is the nutrient content of the feed ration. However, in the process of the storage, the maintenance of the nutritious substances decreases for various reasons that are leading to decreasing livestock efficiency and increasing the cost. The results of the use of a two-phase compaction of the forage vegetable components on the example of the alfalfa are given in the article. The dependence coefficient of the nutritional preservation on density of the alfalfa put on storage are also presented in this article.

The applied method and the results obtained can be used in the development and design offices to create new equipment based on the two-phase compaction of the fodder vegetable component mixes by preparing them for storage. The application of this method brings to decreasing losses of nutrients in the storage process which reduces the components cost in total with increasing additional weights and the milk productivity.

АНОТАЦІЯ
У сучасному промисловому виробництві продукції тваринництва видатне значення відводиться на збереження та ефективної обробітку кормову базу. Основними критеріями оцінки якості кормових компонентів є вміст поживних речовин у кормовому раціоні. Однак в процесі зберігання вміст поживних речовин знижується з різних причин, що призводить до зниження продуктивності тварин і підвищення собівартості продукції. У статті наведені результати використання двухстадійного ущільнення рослинних компонентів кормів на прикладі люцерни. Також представлені залежності коефіцієнтів збереження поживних речовин від щільності залежної на зберігання люцерни. Використанням методу і отримані результати можуть бути використані в розробках конструкторських бюро для створення нової техніки заснованої на двохстадійному ущільненні рослинних компонентів кормових сумішей при зберіганні їх до зберігання. Застосуванням даного методу призводить до зниження втрат поживних речовин в процесі зберігання, що зменшує витрати на заготівлю компонентів в сукупності з підвищенням приrostів і надій.

INTRODUCTION
The preservation of nutrients in feed crops in the storage process is of great importance affecting the vital functions of the livestock, their productivity and the quality of the obtained products (Liu et al., 2018; Mikula et al., 2018; Katsande et al., 2019). To a large extent the preservation of the feed components depends on the conditions of their storage and compacting (Wang et al., 2010; Santos et al., 2016).
Taking into account the peculiarities of the voluminous fodder structure, it should be noted that in order to achieve the high-quality plant raw materials indices when laying in storage the degree of the compaction is of particular importance. It is also necessary to take note of the effect of the residual relaxation which occurs after the removal of the load and, as a result, a retraction of the oxygen in the air mixtures which leads to the negative consequences namely to the oxidative processes that increase in general the nutritional value of canned food (McCormick et al., 2011; Maraldi et al., 2016; Cobletz et al., 2015, 1996; Stoškus et al., 2019). As a result of the dairy cows activity, alcohols and other oxygen-containing forms are released as well. Lower concentrations of highly reactive alkenes and aldehydes were also detected (Malkina et al., 2011).

MATERIAL AND METHODS
The technology of a two-phase compaction is realized by a constructive technological line which is shown in Fig. 1, a. It allows to decrease the relaxation effect after removal and find the way out from a current situation. Two-phase compaction technology increases the quality of the feed preservation and declines its cost. An experimental installation of the two-phase compaction line is shown in Fig. 1, b.

The research is based on revealing the influence of the constructive and technological parameter line on the quality indicators of the preserved plant raw materials and on comparing them with the traditional harvesting and storage methods.

The laboratory installation consists of the squeezer of a preliminary compaction, 2, (first phase of compaction) and a two-screw compactor 4, which are mounted on the frame 1. At the same time on the two-screw compactor is mounted a dozer of free-flowing preservatives, 3. The installation will be started by the asynchronous electric motors. The drive mechanism of the preliminary compaction squeezer is a screw, a dozer of preservatives and the two-screw compactor are positioned catenary. The piston sizes of the preliminary compaction squeezer were 300x400 mm, with the stroke of the piston 700 mm. The diameter of the screws was 150 mm, the length was 800 mm and the overlap value was 50 mm. The diameter of the dosing drum was 200 mm, with a cell diameter of 3 mm and a depth of 1.5 mm. The alfalfa in the flowering phase was used during the experiment.

The preservation quality of plant materials after two months of storage was investigated. The combustion heat, total nitrogen and crude fibre were measured.

RESULTS AND DISCUSSION
The ash-content research solution is presented in Fig. 2 and the results are given in Table 1. As a result of carrying out the chemical analyses, combustion heat of vegetable raw material samples was defined and the results are given in Table 2.

According to the Kjeldahl method, the presented samples of plant materials were analyzed for the content of crude fat, crude fiber and total nitrogen.
Table 1

| Sample no. | Mass of crucible [g] | Mass of crucible with hitch [g] | Mass of crucible with hitch after desiccation [g] | Mass of hitch [g] | Mass of ash [g] | Ash-content [%] | Average ash-content [%] |
|------------|----------------------|---------------------------------|-----------------------------------------------|------------------|----------------|----------------|------------------------|
| 1          | 87.7602              | 90.8674                         | 88.4526                                       | 3.1072           | 0.6924         | 22.28          | 18.97                  |
| 2          | 90.4581              | 93.4624                         | 91.0020                                       | 3.0403           | 0.5439         | 18.10          |                        |
| 3          | 78.4418              | 81.6450                         | 78.9714                                       | 3.2032           | 0.5296         | 16.53          |                        |

The results of the experiments proved that the crude fat content in the samples made up 2.25% as it was determined by the Soxhlet method.

Table 2

| Sample no. | Hitch, n [g] | Normal of Mohr’s salt, K | Control, [ml] | Volume of solution of Mohr’s salt for the sample [ml] | Heat of combustion, Q [kcal/g] | Heat of combustion. Average value Q_ave [kcal/g] |
|------------|--------------|--------------------------|---------------|-----------------------------------------------------|-----------------------------|---------------------------------------------|
| 1          | 0.0250       | 24.6                     | 51.4          | 24.3                                                | 4.05                        | 4.047                                       |
| 2          | 0.0227       |                          |               | 24.6                                                | 4.01                        |                                             |
| 3          | 0.0212       |                          |               | 25.5                                                | 4.08                        |                                             |

Fig. 2 – Carrying out chemical researches on ash-content measurements

a) drying of samples; b) burning of samples in the muffle furnace; c) cinder remains
The results of the vegetable raw materials researches on the crude cellulose content are presented in Table 3.

### Table 3

| Sample no. | Hitch, n [g] | Normal of Mohr’s salt, K | Control, [ml] | Volume of solution of Mohr’s salt for the sample [ml] | Content of crude fibre [%] | Average value [%] |
|------------|--------------|--------------------------|---------------|---------------------------------------------------|---------------------------|------------------|
| 1          | 0.0510       | 24.6                     | 48.5          | 36.4                                              | 16.01                     | 20.22            |
| 2          | 0.0511       |                          |               | 31.0                                              | 23.12                     |                  |
| 3          | 0.0552       |                          |               | 30.9                                              | 21.52                     |                  |

Due to chemical expertise, the content of total nitrogen was determined, and the results of these tests are given in Table 4.

### Table 4

| Sample no. | Variant 1 | Variant 2 | Variant 3 | Average value | Delta | Content of nitrogen [%] | Average content of nitrogen [%] |
|------------|-----------|-----------|-----------|---------------|-------|------------------------|--------------------------------|
|            | Alfalfa condensed after harvesting |            |            |               |       |                        | 2.45                           |
| 1          | 2.8       | 2.6       | 2.7       | 2.70          | 3.13  | 2.44                   |                                |
| 2          | 2.6       | 2.8       | 2.8       | 2.73          | 3.10  | 2.41                   |                                |
| 3          | 2.6       | 2.6       | 2.7       | 2.63          | 3.20  | 2.49                   |                                |
| Control    | 5.8       | 5.8       | 5.9       | 5.83          | -     | -                      |                                |

Process of carrying out the titration of the surplus of the sulfuric acid alkali solution is presented in Fig. 3.

Fig. 3 – The process of determining the total nitrogen content by titration
CONCLUSIONS

The chemical composition analysis of the fodder material was carried out in the Dmytro Motornyi Tavria State Agrotechnological University chemical laboratory. The results of the nutrient preservation depending on feed density (extent of compaction) are presented in Fig.4.

![Preservation Coefficient of Nutrients vs Plant Materials Density](image)

**Fig. 4 – Results of determination of plant materials safety coefficients**

On the basis of the vegetable raw materials chemical analysis put in the polymeric storages on the offered technology, the following data were obtained: the content of the crude fat (CF) was 2.25% by definition of the Soxhlet extractor, the crude fibre content (CFi) was 20.22%, the crude protein content (CP) was 14.5%. The submitted data confirm a high quality of the received fodder weight. Also, the high quality confirmed the production tests in the farms of the Zaporizhia and Kherson regions.

The data obtained show, that the degree of compaction of plant materials has an optimum, being at the level of 0.78 - 0.82 t/m³. As the density of plant materials increases during packing, there is a destruction of its cellular structure, which means disintegration and oxidation of nutrients. On the contrary, at the insufficient compaction, a considerable development of the pathogenic micro flora occurs which leads to the development of putrefactive and other anaerobic bacteria.

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