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IMPORTANCE OF CARRIER FOR FEED PREMIXES PRODUCTION
VAŽNOST NOSAČA U PROIZVODNJI PREDSMEŠA

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SUMMARY

Production of feed premixes is significant aspect of feed production. Even the premixes are designed for market or used directly for feed production, it is necessary to achieve homogeneity of all ingredients at 1:100.000 ratio. Different kind and quantities of microingredients has been used depends on species and categories of animals but in whole quantity of product, carrier takes a remarkable part. According to mentioned requirements, it is necessary to assure carrier with suitable physical and chemical properties. Different kind of carriers and their combination have been examined as well as homogeneity of premixes. Results are shown through the coefficient of variation.

***Key words**: carrier for feed, premixes, production*

REZIME

Proizvodnja predsmeša za ishranu životinja predstavlja značajan aspekt proizvodnje hrane za životinje. Bez obzira da li se radi o proizvodnji premiksa za tržište ili se koriste za proizvodnju hrane za životinje unutar procesa, neophodno je postići homogenost sastojaka u odnosu 1:100.000. U zavisnosti od vrste i kategorije životinja, koriste se različite vrste i količine mikroingredijenata ali u ukupnoj količini proizvoda, nosač ima najveći udeo. Prema prethodno navedenim zahtevima, neophodno je obezbediti nosač sa pogodnim fizičkim i hemijskim osobinama. U ovom radu su ispitane različite vrste nosača kao i njihovih kombinacija, a takođe i homogenost predsmeša napravljenih sa istim nosačima. Rezultati analiza su interpretirani kroz koeficijent varijacije, kao merila homogenosti.

***Ključne reči**: nosač, predsmeša, proizvodnja*

INTRODUCTION

Today, contemporary feed production is unthinkable without adding of vitamin-mineral premixes. Content and quantity of vitamins, minerals, enzymes and significant number of other additives depends on species and category of animals, their requirements, content of meal, level of production etc.

To avoid negative effects and fulfil optimum requirements, concentration and ratio of all ingredients components should be very well balanced, so formulation of premix is an important and critical step in manufacturing a premix. The formulator has to consider source of ingredients based on their physical, chemical characteristics, bioavailability, their interactions when mixed, handling characteristics, and economic implications on the final product before any final conclusion is arrived at.[8,17].Premixing has progressed from the simple hand mixing of several ingredients to mechanical mixing, to continuous mixing, and now to computer controlled mixing. However, the basic concept of mixing ingredients together to result in a homogeneous blend has remained unchanged [8,17]. Premixing of micronutrients with a suitable carrier is a common method used to ensure proper distribution of these nutrients in the final feed. This dilution must be one accurately and carefully under a strict quality control program. Vitamins, trace minerals, antibiotics, mold inhibitors, and flavors are predominately added to feeds in the form of premixes. Inclusion rates of 10 kg to 50 kg per ton of complete feed are common and depend on the mixing equipment available and type of feed being produced [1].

The premix process requires careful attention to each of the following to ensure success:

- formulation of premix
- selection of carriers or diluents
- use of dust control and binding agents
- type of mixer used
- sequence of ingredients added to the mixer
- sequence of mixes and mixer clean-out
- selection of packaging material
- labelling
- date coding
- storage

Selection of carrier and its percentage is important for formulating a quality premix. It is generally preferable to leave sufficient space for a carrier in order to minimize any sort of interactions between the active ingredients. The carrier should serve the functions as showed below [8,15] :

- It should neutralize the electrostatic charges present in certain ingredients.
- Chemically inert
- Primarily have the density, particle shape and particle size compatible with other micro ingredients so as to prevent any demixing in the premix.
- Water sequester from other raw materials thereby reducing water activity and improve stability of the premix.
- Impart good flowability.

Types of carrier widely used in the formulation of premix are [8,13]:

A. Organic carriers
B. Inorganic carriers

Table 1. List of carriers common used in premix
Tabela 1. Lista nosača koji se uobičajeno koriste

Organic carriers *Nosači organskog porekla*	Inorganic carriers *Nosači neorganskog porekla*
Wheat middling *Pšenične mekinje*	Calcium carbonate (limestone) *Ca-karbonat (kreda)*
Wheat feed flour *Pšenično stočno brašno*	Dicalcium Phosphate *Dikalcijum fosfat*
Corn meal, grounded corn *Kukuruzno brašno*	Monocalcium phosphate *Monokalcijum fosfat*
Soyabean meal *Sojino brašno*	Zeolite *Zeolit*
Lactose *Laktoza*	Fine dried salt *Fino samlevena so*

Physical Characteristics

Particles of uniform size, density and that of spherical shape blend well to form a homogenous mixture. The chance of segregation is thereby minimized. For example trace minerals available in the market are invariably found to be coarse in nature whereas the vitamins are normally fine powders. Achieving a homogenous mixing of these two ingredients would be difficult (sand and pebble effect). However, homogenous mixing can be achieved by processing the trace minerals to the desired particle size and improved flowability [8,6, 10].

Chemical Characteristics

Potency of vitamins, trace minerals and medicaments need to be considered whilst formulating high quality premixes. Based on the customer's requirement the formulator has to include the micronutrients considering their analytical value so that desired amount can be delivered when mixed in the feed. No materials should be incorporated in the premix without analysis since under or over addition may have deleterious effect on the overall performance of the animals consuming the feed.

Better premixes can often be prepared by employing a blend of predetermined ratio of several diluents rather than with just one. The organic carrier absorbs moisture while inorganic carrier contributes towards density of premix [5, 6, 8, 10, 17].

Table 2. Physical and chemical characteristics of carrier
Tabela 2. Fizičke i hemijske osobine nosača

Physical characteristics *Fizičke osobine*	Chemical characteristics *Hemijske osobine*
Particle size *Veličina čestica*	Potency *Jačina*
Particle shape *Oblik čestica*	Purity *Čistoća*
Particle density *Gustina čestica*	pH *pH*
Flowability *Protočnost*	Reactivity *Reaktivnost*
Compressibility *Moć sabijanja*	Stability *Stabilnost*

Premix micro ingredients such as drugs, vitamins, and trace minerals with a suitable diluent prior to their inclusion in a supplement. Diluents serve to dilute the micro ingredient and thereby facilitate the rate of mixing. Examples of suitable diluents include the macro minerals typically incorporated in a feed mix (ie. salt, limestone, dicalcium phosphate, magnesium oxide). Diluents should be dry in order to permit a more uniform dispersion of individual micro ingredient particles. Moisture must be avoided as it may cause entrainment and clumping (hygroscopic compounds such as urea are not suitable diluents). The premix (micro ingredients plus diluent) should represent 3%, by weight, of the supplement. Premixing may be done by hand in a large container. However, it can be performed more easily and efficiently by means of a small portable cylinder mixer [18].

Compatibility of the carrier

A carrier is compatible if two criteria are met:

- The particle size profile of the carrier encompasses that of the other component to be mixed.
- The density of the carrier is of the same order as that of the other components

In practice, it is accepted that it is possible to obtain a stable mixture when the ratio of density of the two components (carrier/component) is between 1 and 3 [3,8].

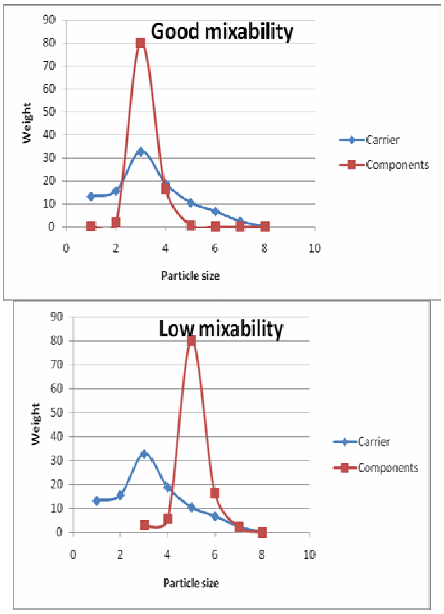


Fig. 1. Examples of mixability according to particle size distribution
Sl. 1. Primeri sposobnosti mešanja prema raspodeli veličine čestica

Mixing time

The mixing time is also crucial for obtaining a homogenous premix. It is evident that shorter mixing time leads to under mixing while prolonged mixing time results in demixing. By trial and error and also by conducting coefficient of variation studies, optimum-mixing time can be arrived for a particular mixer.

Mixing order

The sequence of addition of various ingredients while loading the mixer can affect the quality of premix. If proper mixer loading sequence is not followed, oil balls, chemical interactions and particle segregation can result in a premix.

Regular mixer evaluation should be accomplished by conducting coefficient of variation studies. C.V value of less than 5% is indicative of excellent mixing. The mean assay value for the tracer should also be within the permissible limits of analytical variation. Any deviation from the expected result indicates any one of the following [1, 11, 12]:

- Improper mixing time
- Irregular mixing order
- Selection of bad mixer
- Improper alignment of mixing aids
- Wear out of internal part
- Larger analytical variations

Lack of uniformity in a premix is compounded when mixed into finished feed (multiplier effect) [7, 8, 17].

MATERIAL AND METHODS

Six different kind of carriers and combinations of carriers were examined according to their physical properties. Next types of carriers were used:

- wheat feed flour
- grounded corn
- wheat middlings
- limestone
- mixture of limestone and wheat feed flour (50:50 ratio)
- mixture of limestone, wheat feed flower and grounded corn (30:30:40)

It was performed granulometric analysis and also bulk density of carriers.

Granulometric analyse was determined by ISO method of sieving [4,9]

Bulk density was determined by method of DIN [2].

Carriers were used for preparing of premixes in two-step mixing procedure. Microelements and Microtracers® were mixed 5 minutes in small mixer together with small quatity of carrier and after that added in big double shaft mixer (200 kg per charge) and mixed for usuall mixing time (10 minutes).

Ten samples were taken for each batch and homogeneity was detemined by method of Microtracers® [14,16].

The results are shown as coefficient of variation.

RESULTS AND DISCUSSION

The results of granulometric analyses of carriers are showed below (Table 3 and Figure.2)

Table 3. Sieve analyse of used carriers
Tabela 3. Analiza sejanja upotrebljenih nosača

Sieve oppening /*Otvor na situ* (mm)	Sieve remain/*ostatak na situ* (%)					
	Wheat feed flour and limestone/*Pšenično stočno brašno i kreda*	Grounded corn/ *Samleven kukuruz*	Wheat feed flour/ *Pšenično stočno brašno*	Limestone/*Kreda*	Wheat middlings/*Pšenične mekinje*	Limestone+wheat feed flour +grounded corn/*Kreda+pš. stočno brašno/samleven kukuruz*
2	5.8	9.7	0	0	13.2	8.3
1.25	16.6	19.2	0	0	15.6	17.3
1	11.3	10.5	0.2	0	32.8	11.6
0.63	18.3	20.6	1.9	0	18.8	19.5
0.25	25.8	26.2	80.1	0	10.5	30.4
0.125	17.6	11.7	16.3	68.5	6.7	11
0.063	4.3	1.3	0.7	25.6	2.4	1.2
Bottom / *dno*	0.1	0	0	5.9	0	0.7

As we can see in Table 3 the best distribution of particle size have wheat feed flour and limestone. It can be concluded that good homogeneity with satisfactory coefficient of variation (<5%) would be achieved.

The other types of carriers have unsatisfactional distribution according to particle size where there are wide range of distribution from coarse to very fine particles.

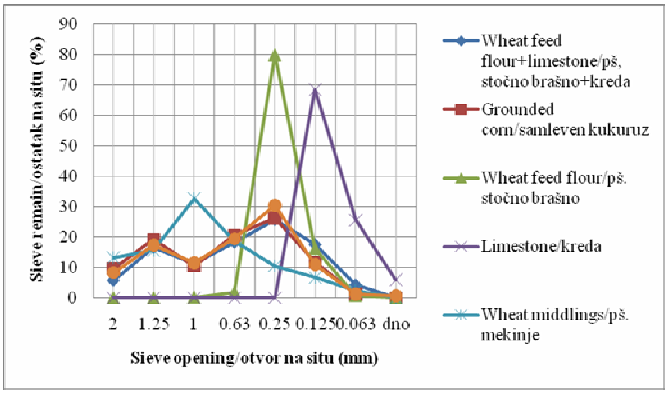


Fig. 2. Grafic view of granulometric analyse of used carriers
Sl. 2. Grafički prikaz granulometrijske analize upotrebljenih nosača

But, according to bulk density of the carriers particulary and mixture of the other components (Figure 3) there is a big difference between bulk density of limestone and the other components. In this case, use of limestone as carrier is not appropriate so results of the coefficient of variation (Table 4) has shown that it is not possible to achieve a good homogeneity of premix.

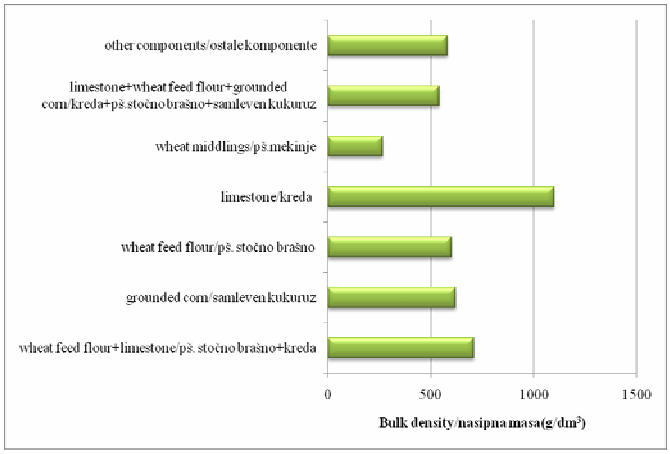


Fig. 3. Bulk density of used carriers
Sl. 3. Nasipna masa upotrebljenih nosača

Other data in the Table 4 have shown that coefficient of variation <5% was achieved at mixing where wheat feed flour had been used as carrier. There is the best combination of particle size distribution as well as bulk density.

The highest CV was marked in case of use of wheat middlings as carrier, as the least appropriate carrier with bad particle size distribution and very low bulk density. The results have shown that it is possible to predict mixability of some premixes according to type of used carrier and it's properties (physical properties-particle size and distribution, bulk density, flowability). It is very useful for feed premixes producers to determinate all possible factors that affecting mixing uniformity and to addapt processes to the available components and process conditions.

Table 4. Coefficient of variation of mixture's homogeneity with different carriers

Tabela 4. Koeficijent varijacije homogenosti smeša sa različitim nosačima

	Type of carrier					
	Wheat feed flour and limestone/ *Pšenično stočno brašno i kreda*	Grounded corn/*Samleven kukuruz*	Wheat feed flour/*Pšenično stočno brašno*	Limestone/*Kreda*	Wheat middlings/ *Pšenične mekinje*	Limestone+wheat feed flour +grounded corn/ *Kreda+pš.stočno brašno+samleven kukuruz*
Coeff. of variation/*Koeficijent varijacije*CV (%)	9,5	11,6	4,8	13,5	23,5	10,2

CONCLUSION

The formulator has to consider source of ingredients based on their physical, chemical characteristics, bioavailability, their interactions when mixed, handling characteristics, and economic implications on the final product before any final conclusion is arrived. Selection of carrier is important for formulating a quality premix. Carriers as a remarkable part of premixes, should meet a few requirements to assure a good mixability and required mixing uniformity. It is necessary to choose carrier with adequate particle size and particle size distribution, bulk density and properties according to the other components.

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