

INFLUENCE OF MIXING-DISTRIBUTION TRAILERS DESIGN ON FEED DISTRIBUTION UNIFORMITY

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Abstract: The aim of this investigation was analysis of main mixing-distribution trailer working parameters. This will serve as a base for evaluation of possibilities for obtaining better feed preparation quality on farms, more uniform feed distribution, higher productivity and energy saving.

Results have shown that different conceptions of mixing-distribution trailers have different quality of food distribution. Best uniformity of distribution was achieved by using of trailer with horizontal mixing rotor and with tiller for silage cutting and loading.

Key words: *mixing-distribution trailer, mixing device, uniformity of distribution*

Introduction

Preparation of quality meal on farms is one of the most important parts in breeding processes, if the high quality is to be expected. Mixing-distribution trailers are technical solution that can put together meal preparation, mixing and its distributions to all farm structures and buildings. Main tasks of mixing-distribution trailer are homogenization of feed concerning its numerous components and its uniform distribution. Uniformity of meal distribution should not cross 10 - 15% [4]. In free keeping systems this value can be higher but not more than 20%.

Material and Method

Four different mixing-distribution trailers were investigated regarding uniformity of distribution. Characteristics of trailers are shown in Table 1.

Tab. 1 Technical characteristics of trailers

Technical parameter	Trailer			
	A	B	C	D
Length of trailer [mm]	4830	6990	9520	5650
Width of trailer [mm]	1950	2260	1850	2060
Height of trailer [mm]	2840	2850	2670	2670
Maximal height of trailer [mm]	2840	5670	4850	2670
Trailer mass [kg]	4100	6300	6900	4100
Capacity [m ³]	10	12	15	12
Rotor type	vertical	horizontal	horizontal	vertical
Number of rotors	1	2	2	2
Year of production	2003	2003	2003	2003
Side elevator speed [m/s]	0.38	0.35	0.34	0.38

Trailers were tested in dairy cattle farms «Pionir»-Besni Fok, «Partizanski prelaz»-Vrbovsko and «Mladost»-Jabuki Rit (working units of Agricultural Cooperation Belgrade) from 20.01.2005 up to 10.02.2005. Outdoor temperature was from $-4 \text{ }^{\circ}\text{C}$ in the morning, up to $5 \text{ }^{\circ}\text{C}$ during the day. Relative humidity was 88-94%. Based on feeding technology and regime for dairy cattle maize silage, concentrate in briquettes, alfalfa hay and beer pomace. Meal, formed by mixing of all these components, is given two times a day in two combinations:

I - silage : hay : concentrate = 83 : 7 : 10

II - silage : hay : concentrate : beer pomace = 80 : 6 : 9 : 5

Trailers were tested in the open and in the farms. Optimal capacity and uniformity of distribution were investigated. For data analysis statistical method with variation coefficient was applied.

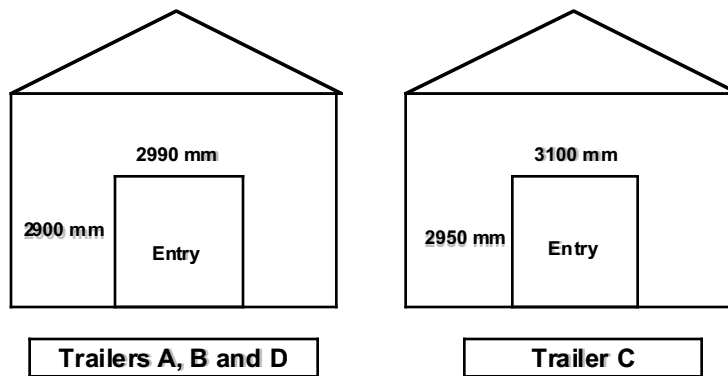


Fig. 1. Farm buildings structure

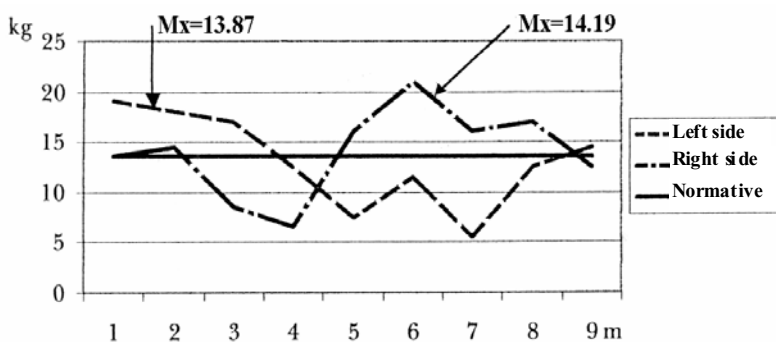
Results and Discussion

During investigation trailed speed was varied and position of openings (0 to 10 and 10 to 20) on side elevators. These two parameters directly influence on mass discharged (Mx – meal mass needed) and uniformity of disposal (Cv). Table 1 gives uniformity of food distribution for trailer A.

Tab. 1. Uniformity of distribution for trailer A

Test	Total mass (kg)	Speed (km/h)	Side elevator speed. (m/s)	Position of side opening	Average value of ejection - Mx (kg)		Uniformity of distribution - Cv (%)	
					left side	right side	left side	right side
1	1940	1.14	0.38	III	13.55	11.8	1.03	7.53
2	1940	1.22	0.38	III	15.2	14.8	4.03	1.92
3	1940	1.14	0.38	II	6.5	6.3	23.76	24.86
4	1940	1.41	0.38	IV	20.45	24.9	21.21	33.75
5	1940	1.38	0.38	III	13.65	13.15	2.32	3.27
Average	1940	1.25	0.38		13.87	14.19	10.47	14.27

For trailer speed of 1.25 km/h uniformity of distribution on the left side was 10.47% and on the right side 14.27% which presents a good working quality concerning proposed meal composition. Problem in exploitation can be of different uniformities for left and right side. Average discharge rate Mx = 13.87 kg on the left side and 14.19 kg on right side had fulfilled given task of 13.5 kg/cow (graph. 1).



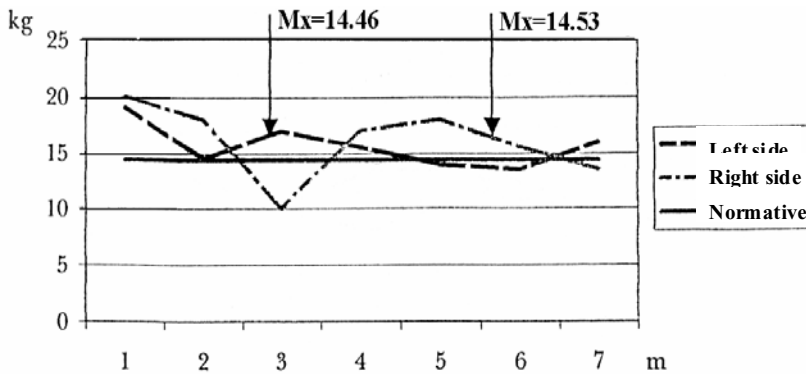
Graph. 1. Stability of trailer A discharge.

Table 2 gives uniformity of meal distribution for trailer B.

Tab. 2. Uniformity of distribution for trailer B

Test	Trailer speed km/h	Gear position	Position of side opening	Average discharge - Mx (kg)		Uniformity of distribution - Cv (%)	
				left side	right side	left side	right side
1	2.97	III sp.	10	15.64	16.00	4.10	5.06
2	4.99	IV sp.	10	10.30	11.20	14.38	11.46
3	4.54	IV sp.	20	10.80	12.80	12.65	5.95
4	2.85	III sp.	20	21.12	18.12	23.02	12.35
Average	3.83	-	-	14.46	14.53	13.54	8.71

For trailer speed of 1.25 km/h and side opening in position 10 uniformity of distribution on left side was 13.54 % and on the right side was 8.71 %, which presents a good working quality concerning proposed meal composition.



Graph. 2. Stability of trailer B discharge

It can be seen, from graph 2, that uniformity of mass distribution from both side of normative line and that Cv spans are not so big. This stability in work shows that correlation parameters Mx and Cv are in optimal correlation.

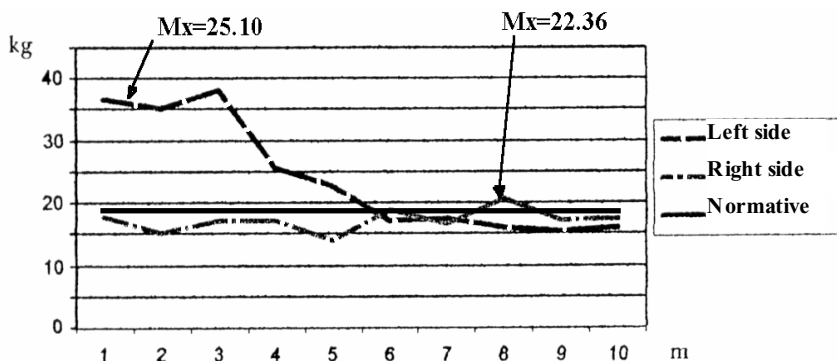
This investigation shows that there are lot of combinations and different possibilities for programming working regime of trailer. In this case, speed increasing of only 0.2 – 0.3 km/h can perform a good working quality that is proposed by methodology. This means that trailer B has good working parameters.

In table 3 uniformity of food distribution for trailer C is shown.

Tab. 3. Uniformity of distribution for trailer C

Test	Total mass (kg)	Trailer speed (km/h)	Side elevator speed. (m/s)	Position of side opening	Average discharge - Mx (kg)		Uniformity of distribution - Cv (%)	
					left side	right side	left side	right side
1	5.000	2,21	0,34	I	13,95	11,65	19,86	21,42
2	5.000	2,45	0,34	III	48,07	34,25	40,92	23,78
3	5.000	2,33	0,34	II	21,65	20,20	6,15	4,32
4	5.100	1,50	0,34	I	24,6	27,6	0,90	10,48
5	4.700	1,58	0,34	I	17,25	18,08	13,98	8,56
Average	4960	2.01	0.34	-	25.10	22.36	16.36	13.71

Based on data shown in table 3 it can be concluded that there are huge deviation for given normative. Average discharge on left side was 25.10 kg and on the right side 22.36 kg. These values are too high compared to given normative. It can be concluded that working quality of this trailer is not satisfying. Uniformity of distribution on the left and on the right side is not at desired level (Graph. 3).



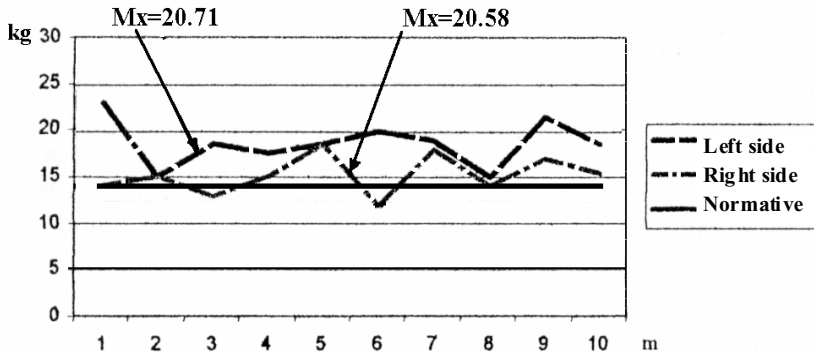
Graph. 3. Stability of trailer C discharge

Table 4 gives the results uniformity of distribution for trailer D.

Tab. 4. Uniformity if distribution for trailer D

Test	Total mass (kg)	Trailer speed (km/h)	Side elevator speed (m/s)	Position of side opening (cm)	Average discharge - Mx (kg)		Uniformity of distribution - Cv (%)	
					left side	right side	left side	right side
1	2320	1.30	0.38	27.5	18.02	12.55	6.50	19.50
2	2320	0.93	0.38	27.5	24.50	31.80	9.15	27.25
3	2320	1.45	0.38	37.5	19.20	24.50	3.64	9.52
4	2320	1.67	0.38	37.5	21.14	13.50	1.04	17.20
Average	2320	1.34	0.38	32.5	20.71	20.58	5.08	18.36

For trailer speed of 1.34 km/h and side opening of 32.5 cm, uniformity of distribution on the left side was 5.085 and on the right side 18.36% which presents non-satisfying working quality concerning given normative. Average mass discharge on the left side was 20.71 kg and on the right side 20.58 kg. These values are much higher than given normative (14.4 kg/cow) and are in the range of 40% deviation from normative value (graph 4). Uniformity of distribution on the left and on the right side is also a problem observed for this trailer.



Graph 4. Stability of trailer D discharge

Conclusions

Mixing-distribution trailer A is suitable for working conditions on the farm. Average meal discharge and uniformity of distribution are in compliance with given normative. Mixing procedure and its quality respond to given working regime. Mixing-distribution trailer B showed the best results in uniformity of distribution as well as in average food discharge. Quality of mixed meal is satisfying. Mixing-distribution trailer C does not fulfill given normative and does not have satisfying working parameters in sense of distribution uniformity as well as in the sense of food discharge. Huge differences in left and right side distribution are observed by the use of this trailer. Mixing-distribution trailer D does not satisfy given normative and working quality. By use of this trailer the great deviation is shown in left and right side distribution uniformity.

From obtained results it can be concluded that trailers with horizontal rotor have better uniformity of feed distribution if compared with trailers with vertical rotor. Although, it must be stated that horizontal position of rotor significantly influences on design as well as on dimension of trailers and this could be limited factor in actual livestock buildings. In that case, main recommendation for future investments in livestock production and buildings must obtain these estimated factors.

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UTICAJ KONCEPCIJE MIKSER PRIKOLICA NA UNIFORMNOST DISTRIBUCIJE HRANIVA

Abstrakt: Cilj ovog rada je analiza parametara rada savremenih mikser prikolica u uslovima eksploatacije, kako bi se sagledala mogućnost pripreme kvalitetnijeg obroka sa stanovišta mešanja i homogenizacije, ostvarila bolja ravnomernost distribucije pripremljenog hraniva, povećala produktivnost rada i smanjila potrošnja energije.

Na osnovu podataka određeni su ravnomernost distribucije hraniva i prosečna količina izbačene mase. Analizom dobijenih rezultata konstatovano je da mikser prikolice sa horizontalnim rotorima daju bolje rezultate u pogledu ravnomernosti distribucije hraniva.

Ključne reči: Mikser prikolica, koncepcija, ravnomernost distribucije, količina hraniva.

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