Production of Urea Molasses Blocks for Ruminant Animals in Malaysia

Akinori OSHIBE[a] and Mohamed Wan ZAHARI[b]

[a] *Animal Production and Grassland Division, Japan International Research Center for Agricultural Sciences (Tsukuba-shi, 305-8686, Japan)*

[b] *Livestock Research Center, Malaysian Agricultural Research and Development Institute (P.O. Box 12301 GPO 50774 Kuala Lumpur, Malaysia)*

Received December 13, 1996

Abstract

An efficient processing technique and suitable urea molasses block (UMB) composition for the application of the technique were developed at the Malaysian Agricultural Research and Development Institute (MARDI) for semi-commercial UMB production. The technique consists of grinding and mixing solid components, mixing the solid components with molasses and moulding. The UMB formulae suitable the application of the technique contained more than 50% of molasses, less than 25% of filler, less than 10% of binder and more than 10% of salt in total weight. The UMB processed by the technique led to a better performance of growing lambs than commercial UMB under the current experimental conditions.

Additional key words: processing technology, supplemental feed

introduction

Despite the abundance of various agricultural by-products, Malaysia is still a net importer of feed ingredients. By using with molasses, urea and other ingredients, these materials can be made into UMB, promising and practical feed supplements for ruminants [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. Recently, a suitable UMB formulae using efficient processing technology has been developed at the Malaysian Agricultural Research and Development Institute (MARDI) for semi-commercial UMB production through the collaboration between MARDI and JIRCAS. This paper reports on the method of UMB processing and its effects on the performance of ruminants.

Materials and Methods

1) *Effect of difference in processing method on variation in the uniformity of UMB*

UMB with a certain composition was used to examine the effect of the difference in the processing method on the variation in the uniformity of UMB (Table 1). A total 36 blocks (2kg each) were prepared using 3 procedures

(Tables 2-1, 2-2). Hardness measured at 12 points with a soil hardness meter (Type SHM-1, TAKEMURA DENKI SEISAKUSHO Co. Ltd.) at the end of the drying period was used as an index of uniformity of the UMB. Statistical analysis was performed using the SAS statistical package. Data were subjected to an analysis of variance. Comparison of mean hardness of each block within a batch was performed by Duncan's multiple range test.

2) UMB processing line

A processing line for UMB was designed and developed at MARDI (Fig. 1). Solid components for UMB were ground and mixed for 3 min at 3000

Table 1. Composition of UMB

Ingredient	Weight percent
Molasses	38
Rice bran	18
CaO	10
Salt	10
Urea	10
$CaCo_3$	1
Zeolite	4
Poultry manure	2.5
Mineral mix	1
Ferrous sulfate	0.5
Triple super phoshate	5

Table 2-1. Procedures

	Procedures	
A	B	C
1) Weigh solid component Total weight 310g	1) Weigh solid components (14.88kg) and molasses (9.12kg)	1) Weigh Soild components (4.96) and molasses (3.04kg)
2) Blend solid component for 3 min with a blender (Capacity:1l)		
3) Put blended powder in a bucket		
4) Repeat 1) to 3) 60 times Total blended solid component, 18.6kg		
5) Mix blended solid component (14.88kg) with molasses (9.12kg) by Mixer A	2) Mix solid component with molasses by Mixer B	2) Mix powder with molasses by Mixer C
6) Molding (2kg×12 blocks)	3) Molding (2kg×12 blocks)	3) Molding (2kg×4 blocks)
		4) Repeat (1) to (2) 3 times *Batch No. C-1 to C-3
7) Drying (6 days)	4) Drying (7 days)	5) Drying (7days)
Batch No. A Blocks No. a-1 to a-12	Batch No. B Blocks No. b-1 to b-12	Batches No. C-1 to C-3 Blocks No. c-1-1 to c-3-4

Table 2-2. Mixers

	Mixer-A	Mixer-B	Mixer-C
Receptacle Capaciry Shape	50l Bowl	150l Drum	16l Bowl
Beater type Rotation Axis	Spiral 3	Propeller 1	Flat 2
Shaft type	Vertical Twin	Horizontal Single	Vertical Single

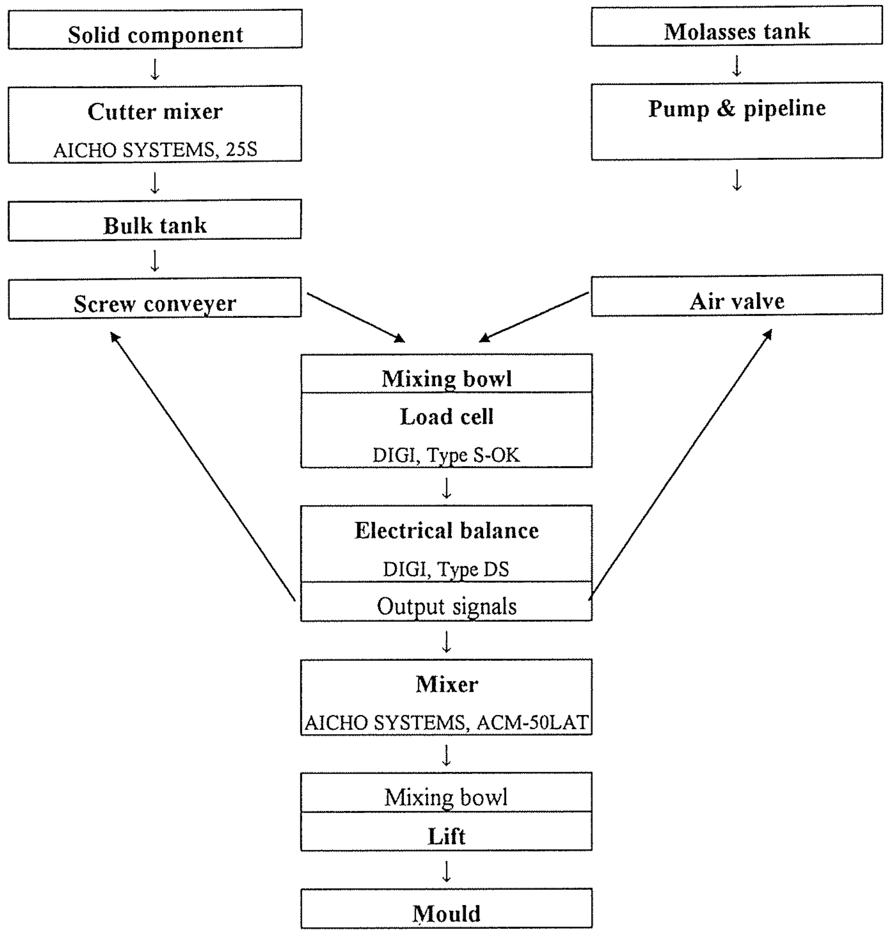

Fig 1. Flow of UMB processing line

rpm with a cutter mixer (25S, AICHO SYSTEM). The mixed solid components were stored in a bulk tank until weighing, while molasses were transported and stored in a tank by using a pump. A screw conveyor for the transfer of mixed solid components from the bulk tank to a mixing bowl was controlled by output signals from an electric balance. An air valve was fixed at the end of a pipeline for the molasses conveyor. The valve and pump for the transport of molasses were also controlled by the output signals from the electric balance. Automatically weighed mixed solid components and molasses were mixed for 5 to 10 min at 200 rpm with a mixer. The mixing bowl was set on a lift for verticall rotating to pour the mixed ingredients into a mould.

3) UMB composition

Seven formulae (for 2kg of each block) were tested in order to determine the liquidity of UMB before solidification (Table 3-A). Every solid ingredient in each formulae was blended using a kitchen blender. The blended ingredients were examined to determine whether they could be mixed with molasses completely for 5 min with the mixer C which had two vertical rotation axes. Each mixed ingredient was transferred into a bowl referred to as "liquidity checker" and the weight was measured (Photo 1). The bowl was trotated vertically and kept for 3 min. This procedure was similar to the procedure A (scale: 1/10). The weight of the remaining portion in the bowl was measured again . Liquidity index (LQD index) was calculated as follows.

Table 3-A. Composition of UMB (weight percent) in relative to liquidity in set

Composition	Molasses	Rice bran	CaO	Salt	Urea	$CaCO_3$	LQD Index
A-1	33	34	33	0	0	0	89.21
A-2	33	44	23	0	0	0	NM
A-3	33	23	44	0	0	0	NM
A-4	50	33	17	0	0	0	NF
A-5	50	17	33	0	0	0	NF
A-6	67	17	16	0	0	0	75.38
A-7	67	22	11	0	0	0	71.25

NM; Cannot to be mixed, NF; does not flow

Photo 1. Liguidity Checker

LQD index = (Wb - Wa)/Wb × 100
Wb: Weight before rotation
Wa: Weight after rotation

Four formulae were tested in order to determine the suitable filler content for UMB in views of processing method (Table 3-B). The molasses contents in this formulae were fixed at 50%. Rice bran was used as the filler. The filler contents were set at 20%, 25%, 28.5% and 30%. Three formulae were tested in order to determine the suitable binder content for UMB (Table 3-C). The contents of molasses and rice bran in these formulae were set at more than 49% and 10% , respectively. Calcium oxide was used as the binder. The binder contents were set at 2.5%, 5.0% and 10%. Two formulae were tested in order to determine the suitable salt content for UMB (Table 3-D). The molasses, rice bran and calcium oxide contents of these formulae were set at more than 64% , 10% and 5%, respectively. The salt content was at 5%, and 10%. Six formulae were tested in order to determine the effect of the difference in the amount of filler on the liquidity (Table 3-E). The molasses, calcium oxide and total filler contents of these formulae were above 61.5% , less than 5.8% and less than 17.3%, respectively. Rice bran and/or soybean were used as the filler(s).

4) Evaluation of UMB intake on animal performance

Twelve Dorset × Malin weaned lambs with a live weight of about 13.5kg were used to observe the palatability of UMB in animals. They were divided into three groups (four lambs each) and fed by group feeding. Wheat chaff (*ad. libitum*) was used as the basal feed. Each group was given blocks WZ42, WZ42B, WZ42C and WZ42D which were placed in random order on a long block folder (free choice feeding) (Table 4.). The weight of the block was measured before and four days after the commencement of the feeding. Sixteen Dorest x Malin lambs (mean live weight 17.3kg) were used in order to compare the effect of UMB on animal growth to that of commercial UMB. They were divided into three groups based on body weight.

Table 3-B. Composition of UMB (weight percent) in relative to filler content (rice bran)

Composition No.	Molasses	Rice bran	CaO	Salt	Urea	$CaCO_3$	LQD Index
B-1	50	20	12.5	5	12.5	0	44±5
B-2	50	25	10	5	10	0	NM
B-3	50	28.5	7.5	5	9	0	NM
B-4	50	30	77.2	5	7.5	0	NM

NM; Cannot to be mixed

Table 3-C. Composition of UMB (weight percent) in relative to binder content (CaO)

Composition	Molasses	Rice bran	CaO	Salt	Urea	$CaSO_4$	LQD Index
C-1	56.5	10	2.5	20	8	3	73
C-2	54	10	5	20	8	3	63
C-3	49	10	10	20	8	3	NF

NF; does not flow

Table 3-D. Composition of UMB (weight percent) in relative to solt contenton the liquidity in set (rice bran and soybean)

	Molasses	Rice bran	CaO	Salt	Urea	$CaSO_4$	LQD Index
D-1	69	10	5	5	8	3	NF
D-2	64	10	5	10	8	3	59

Table 3-E. Composition of UMB (weight percent) in relative to effect of the filler content on the liquidity in set (rice bran and soybean)

	Molasses	Rice bran	Soybean	CaO	Salt	Urea	LQD Index
E-1	61.5	17.3	0.0	5.8	7.7	7.7	66.6
E-2	61.5	7.7	9.6	5.8	7.7	7.7	74.6
E-3	61.5	0.0	17.3	5.8	7.7	7.7	75.7
E-4	75	10.7	0.0	3.6	4.8	4.8	90.9
E-5	75	4.8	6.0	3.6	4.8	4.8	93.2
E-6	75	0.0	10.7	3.6	4.8	4.8	93.0

The first group which acted as a control was fed with oil palm frond silage (containing 6% crude protein) *ad. libitum*. The second group was fed with the same basal roughage and supplemented with commercial UMB (WORMOLAS, OLSSON Industries Pty. Ltd., NSW, Australia). The last group was fed the same basal diet supplemented with UMB (WZ42D) made at MARDI. The experiment was carried out over a period of six weeks. Body weight and UMB intake were measured every week. Live weight was analyzed by Student's t-test with each time point in a group. A probability of less than 5% was taken as criterion for significance of difference from control values.

Table 4. Compositions and hardness of UMB used in animal trials

	% (W)			
	WZ42	WZ42B	WZ42C	WZ42D
Molasses	48	50	55	60
Rice bran	10	9.6	8.6	7.6
Calcium oxide	8	7.7	6.9	6.1
Salt	5	4.8	4.3	3.8
Urea	5	4.8	4.3	3.8
Palm kernel cake	10	9.6	8.6	7.6
Mineral mix	1	1.0	0.9	0.8
Yeast	0.5	0.5	0.4	0.4
Brewers grain	10	9.6	8.6	7.6
Calcium dihydrogen phoshate	1	1.0	0.9	0.8
Zeolite	0.5	0.5	0.4	0.4
Palm oil	1	1	1	1
Mean hardness	20.0	20.6	9.06	0.37

Results and Discussion

1) *Effect of difference in processing method on variation in the uniformity* of UMB

The uniformity of UMB is a prerequisite for commercial production. Chemical composition of UMB (for example mineral content in each block) can be used as an indicator for variation in block quality. However this approach is time consuming, and can not be adopted as a routine method for measuring uniformity. Physical characteristics of the block, (for example hardness) are not necessarily related to its chemical contents. However, compounds with a similar chemical composition and produced by similar processes show similar hardness values when measured under the same conditions. This assumption supports the use of hardness value as a routine indicator for the uniformity evaluation at the industry level. In this experiment, no statistically significant difference was observed in variations within and between the batches of the blocks prepared by procedure A (Table 5.). Significant ($P<0.05$) differences in hardness were observed in batch B blocks. The hardness of blocks b10 and b12 was significantly lower than that of other blocks (b1 to b6 and b9). The variation within a batch may be due to the structure of mixer B. The beater of mixer B rotates on a single horizontal rotation axis. The ingredients of UMB were mixed vertically (top to bottom or bottom to top) only and were not mixed horizontally (right to left or left to right). Hence, the position or the loading ingredients on the drum (either left, center or right) may influence the uniformity. No significant differences were observed in variation within batches C-1, C-2 and C-3. However variation between batches was significant ($P<0.05$) (Table 4.), presumably due to the error in weighing of ingredients. The total weight of ingredients in each batch in procedure C was 1/3 of the weight in procedure A or B. However, the same balance was used in procedures C and B. The accuracy of the balance used in procedures C and B may not be high enough for procedure C. It was concluded that the uniformity of the blocks prepared by procedure A were higher than uniformity of the blocks prepared by other procedures.

Table 5. Variation in hardness within and between batches

Block No.	Hardness	Block No.	Hardness	Block No.	Hardness
a-1	14.51 [ab]	b-1	14.78 [ab]	c-1-1	6.14 [e]
a-2	14.60 [ab]	b-2	14.95 [ab]	c-1-2	6.25 [e]
a-3	14.00 [a]	b-3	15.27 [a]	c-1-3	6.23 [e]
a-4	14.59 [ab]	b-4	14.67 [ab]	c-1-4	13.98 [bcd]
a-5	14.52 [ab]	b-5	14.79 [ab]	c-2-1	15.01 [ab]
a-6	14.62 [ab]	b-6	14.67 [ab]	c-2-2	14.68 [ab]
a-7	14.58 [ab]	b-7	14.53 [abc]	c-2-3	14.63 [abc]
a-8	14.61 [ab]	b-8	14.48 [abc]	c-2-4	14.34 [abc]
a-9	14.50 [ab]	b-9	14.85 [ab]	c-3-1	14.33 [abc]
a-10	14.61 [ab]	b-10	13.45 [cd]	c-3-2	14.55 [abc]
a-11	14.58 [ab]	b-11	14.36 [ab]	c-3-3	14.62 [abc]
a-12	14.55 [ab]	b-12	13.19 [d]	c-3-4	14.33 [abc]

Hardness: kg/cm^2
Different superscript in the same column indicates significant difference ($P<0.05$)

Table 6. Conditions of UMB composition suitable for the present processing method

1. Molasses content:	more than 50 %
2. Filler content:	less than 25 %
3. Binder content:	less than 10 %
4. Salt content:	more than 10 %

2) Design of UMB composition

The operation time for processing becomes an important factor for the cost, especially in mass production UMB. Liquidity or viscosity of the ingredients before solidification largely affects the operation time and in particular the life of the mixer used. Therefore UMB composition is important from the view point of processing line as well as evaluation of its nutritive value. The formulae that contained molasses accounting for 1/3 of total weight were could not be mixed with the mixer (Table 3-A.). Though the formulae that contained 50% molasses could be mixed, it seemed that the liquidity was not sufficiently high to transfer and to mould using a simple device. Rapid expansions was observed in the formulae that contained more than 16% CaO in total weight. Formulae with a high liquidity or low viscosity exerted a beneficial effect in terms of the life of mixer and ease of transfer and moulding. It appeared that formulae which contained less than 50% molasses were not suitable for the present processing method. Though the molasses content was 50%, the formulae that contained more than 25% of filler could not be mixed by the procedure (Table 3-B.). It appeared that the formulae which contained more than 25% of filler were not suitable for the present processing method. Though the molasses content was approximately 50% and filler content less than 25%, the formulae that contain more than 10% of binder shown low liquidity (Table 3-C.). Composition containing more than 60% of molasses, less than 25% of filler, less than 10% of binder showed a low liquidity, when it contained less than 10% of salt (Table 3-D.). The conditions for UMB composition suitable for the present processing method are shown in Table 6. Although the effect of the difference in the amount of filler on liquidity was not appreciable when the molasses content was 75% (Table 3-E.), the difference in the amount of filler or binder largely affected the liquidity, when the molasses content was low.

3) Evaluation of UMB intake on animal performance

The intake of WZ42D was higher than that of other blocks (Fig. 2.). Though it remains to be determined whether the higher palatability of WZ42D was caused by the higher molasses content or lower hardness, WZ42D was superior to other formulae in terms of palatability. The integrated intake of WZ42D was approximately five times higher than that of the commercial UMB at the end of the experiment (Fig. 3.). The body weight of the control group had decreased during the experimental period (Fig. 4.). It appeared that the nutrient contents of basal feed were not high enough to supply the maintenance levels of energy and protein. Supply of energy and protein by commercial UMB also could not reach the maintenance levels, because of low intake. The body weight of the group supplemented with WZ42D was significantly longer ($P<0.05$) than that of the control and the group supplemented with commercial UMB. It was concluded that the performance of the animals which received WZ42D was higher than that of the animals fed WORMOLAS under the current experimental conditions.

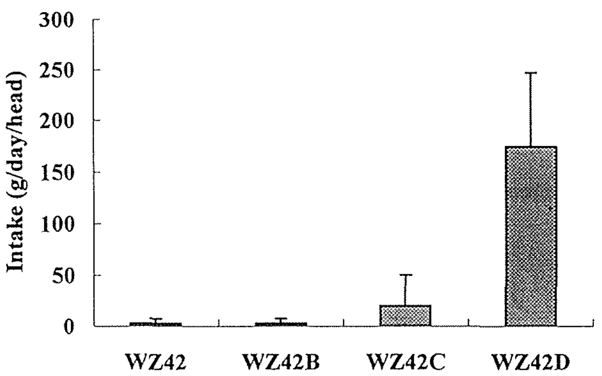

Fig. 2. Effect of UMB composition on animal intake

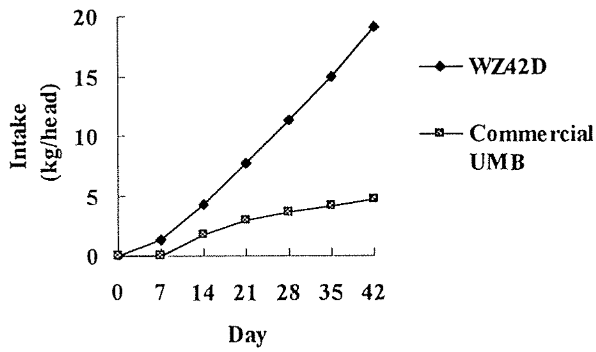

Fig. 3. Change in intake of UMB with time

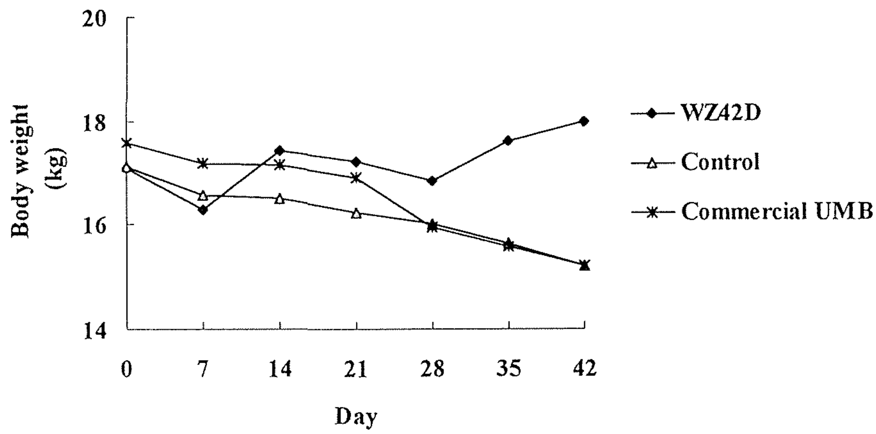

Fig. 4. Changes in body weight

Acknowledgments

The authors thank Mr. M. S. Nor Ismail and Mr. K. Subramaniam for their technical assistance and Mrs. G. I. E. Jayawardene and Miss. M. Liang for their secretarial assistance.

References

1) THE PATENT OFFICE LONDON, No.1315174, 1970, Aug., 6.
2) United States Patent, No.3512986, 1970, May., 19.
3) United States Patent, No.3551162, 1970, Dec., 29.
4) United States Patent, No.3677767, 1972, July ., 18.
5) United States Patent, No.3893842, 1975, July., 8.
6) United States Patent, No.3985912, 1976, Oct., 12.
7) United States Patent, No.4089701, 1978, May., 16.
8) United States Patent, No.4447421, 1984, May., 8.
9) United States Patent, No.4919940, 1990, Apr., 24.
10) United States Patent, No.5250307, 1993, Oct., 5.
11) United States Patent, No.5260089, 1993, Nov., 9.
12) United States Patent, No.5264227, 1993, Nov., 23.

マレイシアにおける反芻家畜用尿素糖蜜ブロックの生産

押部明徳[a)]，Wan Zahari Mohamed[b)]

[a)]農林水産省国際農林水産業研究センター
（〒305-8686　茨城県つくば市大わし１－２）

[b)]マレイシア農業開発研究所
（P.O.Box 12301　GPO 50774 Kuala Lumpur，Malaysia）

摘　要

マレイシア農業開発研究所において，半商業的規模の，効率的な反芻家畜用尿素糖蜜ブロック（UMB）の製造方法とその方法に適するUMB組成を開発した。製造方法は，固体材料の粉砕混合，粉砕混合された固体材料の糖蜜との混合および型詰めによって構成される。この製造方法に適する組成条件は，50％以上の糖蜜，25％以下のフィラー，10％以下のバインダーおよび10％以上の食塩を含む事であった。試験条件下において，この製造方法によって製造されたUMBは市販UMBに比較して緬羊の成長に優れた効果を示した。

キーワード：製造方法，補助飼料