UNCONVENTIONAL FEEDING TECHNIQUES FOR RABBITS IN DEVELOPING COUNTRIES

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Abstract - Results of researches on manufacture and use of blocks and crumbles as feeds for rabbits are described. Trials on growing rabbits at different ages (35, 60 and 70 days) have been performed. Favourable and unfavourable conditions in Developing Countries have been considered. Good growing performances in these conditions (31.0 ± 9.3 g/d) have been obtained with blocks, 40-45 % molasses, to supplement fresh forage based diets. Scarce growth was obtained when the blocks were complete (10.2 ± 5.1 g/d) or they were supplementing poor forages (9.2 ± 3.8 g/d). These limits were overcame with crumbled feeds which, containing a lower amount of molasses (10-15 %), could be fed as sole feed, or even to supplement poor roughage: daily growth rates were 25.8 ± 6.9 g/d and 22,4 ± 5.2 g/d respectively.

INTRODUCTION

Rabbits raised in Developing Countries are usually fed on forages. Supplements, when they are provided, are represented by cereal grains and by-products of different origin (KPODEKON, 1988; LUKEFAHR and CHEEKE, 1991; COLIN and LEBAS, 1995). The main disadvantages of traditional feeding are: wastage (lack of appropriate feeders or racks), scarce hygiene (forages usually administered on the cage floor or on the ground), losses (leaflets of hay, mainly by leguminous plants, drop under the cage), unbalanced composition of different feedstuffs.

Research trials have been performed throughout three years to look for suitable technological solutions able to overcome or to limit such hindrances (FILIPPI BALESTRA *et al.*, 1992; AMICI and FINZI, 1995). Research was focused on simple technologies of blocks and crumbles manufacturing. Particular attention, as possible model, was devoted to separate and to utilise alfalfa hay leaflets, because of their nutritional importance in the frame of proper utilisation of feed resources in Developing Countries (LEBAS *et al.*, 1984; RAHARJO *et al.*, 1986; FINZI, 1987; FINZI *et al.*, 1988). The utilisation of supplementary blocks using sugar-cane molasses as binder, as suggested by BEAMES in 1963 , is now widely diffused to integrate forage based diets or pasture in ruminants. The potential effectiveness of blocks made them recommended in FAO nutritional development programs for ruminants (SANSOUCY, 1986) and also a guideline to manufacture molasses-blocks to supplement low quality forages was edited (AARTS *et al.*, 1990). The inclusion of cement or limestone to increase blocks hardness was also considered by these Authors. The use of sugar-cane molasses to feed rabbits in rural field conditions was observed by KENTOR (1990) and by RIVERON (1995). Molasses to supply energy to a diet based on chopped alfalfa were proposed by SANCHEZ *et al.* (1984). Attempts to manufacture multinutritional molasses-blocks for rabbits have also been performed (BINH *et al.*, 1991; PEREZ, 1994; VELASCO *et al.*, 1994).

Both good and negative results have been obtained by us according to different experimental conditions. It seems useful to treat all these results together to offer a general view of advantages and constraints of small scale rural breeding. It should also permit to take into account different conditions that can be present to develop a flexible feeding strategy for the extension work.

MATERIAL AND METHODS

Attempts to formulate different blocks or crumbles were performed using molasses and cement as binders. Other conditions were: hand manufacturing, use of ingredients usually available in Developing Countries, recovery and inclusion of alfalfa hay leaflets, simulation of availability or not availability of milling devices. In the latter case broken rice and wheat bran were used as provided by local markets. Dry forages were hand cut in pieces as small as possible (length about 2 cm), and alfalfa hay leaflets suffered a partial breaking down when separated from the stems. This was obtained by beating the hay and collecting the leaflets after displacing the stems. Formulations were done in order to obtain roughly balanced blocks or crumbles both complete or to supplement forage based diets (Table 1).

Table 1 : Feeds formulation, main chemical composition and nutritive value (on as fed basis)

Feeds	Blocks				Crumbles	
Components	Complete	Supplement			Complete	Supplem
Alfalfa hay (milled)	14.7	17.2	17.2	--	--	--
Alfalfa hay (leaflets)	--	--	--	27.4	--	14.4
Wheat straw (milled)	16.3	--	--	--	20.9	--
Broken rice (unmilled)	--	11.3	7.1	8.8	--	10.8
Wheat bran (unmilled)	--	17.5	17.6	10.6	24.2	49.2
Wheat meal	--	--	--	--	20.0	12.8
Soybean meal	17.6	--	--	--	21.2	--
Molasses	48.1	50.8	50.1	50.0	11.9	11.8
Cement	3.3	3.2	8.0	3.2	1.8	1.0
Crude protein (%)	14.2	9.3	9.0	12.5	15.5	12.5
Crude fibre (%)	12.0	6.5	6.6	5.9	13.1	8.0
DE* (MJ/kg)	10.1	10.8	9.5	11.2	9.8	10.8

* - Calculated: Maertens *et al.*, 1988.

Only growth trials, lasting ten days or longer periods, have been performed. Different groups of New Zealand White rabbits of different ages: 35, 60 and 70 days, were housed in single cages. This schedule was adopted to avoid the effect of diets which, inducing very different growth rates, make the groups non more comparable after relatively short periods. The most frequent experimental design was : 60 rabbits for each age group assigned to different treatments including industrial pellet and sole forage as control.
Growth performances, feed intake, and feed residuals were recorded weekly or each five days according to the length of the trial. Compared palatability and faeces consistency were noted without specific quantifying. The main characters of the feeds to be considered were defined in preliminary trials. To judge the physical characteristics of the obtained blocks they were classified as "breakable" vs "good hardness", the first character corresponding to "excessive losses", meaning that small particles dropped under the cage. "Good hardness" corresponds to "no losses". "Good density" vs "too light" were also considered characters, since the scarce density was a consequence of the non sufficiently milled ingredients inducing a friable product.
The latter effect brought to attempt crumble formulation and some considered traits were: "formulation problems", "homogeneous", "suitable particles" and "presence of powder". In the tables "non tested" means that the product was judged not suitable in advance. "Not yet tested" means that good perspectives do exist and formulation should be considered in future trials.

RESULTS AND DISCUSSION

The best order to introduce the ingredients in the tank to mix them up was:

1. molasses
2. cement or limestone, melted in a little amount of water (AARTS *et al.*, 1990).
3. Starch rich flower, melted in warm water (only for crumbles).
4. Ingredients (milled at a particle size lesser than 2-3 mm or flower).
5. Larger ingredients (broken rice, bran, alfalfa hay leaflets, and shortly chopped dry forages).

When a large number of blocks have to be prepared, i.e. for commercial purposes, a concrete mixer (SANSOUCY, 1995) is advisable to process the ingredients more rapidly and to spare manual labour. When the mix was put in wooden or metal moulds a melted part was lost. The most effective solution tested was to wind round the mix with any paper (also newspaper). The paper package is very cheap and it made the blocks

manufacturing very simple. The best shape was assessed to be a cylindrical one, measuring cm 8-10 x 15-25. The enveloped cylindrical blocks were easy to be immediately transported to a proper place where they could be sun dried in a few days (3-6 according to temperature and solar radiation) to obtain a water content about 10-14 %, suitable for conservation. By the nutritive point of view the enveloping paper represented no more than 1-2 % of the dry matter of the block and the crude fibre increase was negligible. The paper adsorbed with molasses, thus avoiding losses, was also eaten by rabbits.
To produce crumbles the mix was hand pressed on any hard surface to 1-2 cm thickness. After drying, the mix was crumbled by hand or by stamping after introducing it in sacks. An old simple machinery used to press grape, and very easy to be built, was tested with good results. The dried product had only to be passed through two clogged cylinders of wood. The presence of powder was avoided by the sticky effect of molasses. When producing crumbles on larger scale was simulated, it was possible to sieve the dried material to separate the larger sized pieces to crumb them again.
A limit of blocks formulations was the need to introduce an high percentage of molasses. Best results were obtained with blocks (Table 2) containing 45-50 % molasses administered together with fresh palatable forages. In this case satisfactory growing performances were obtained (31.0 ± 9.3 g/day). Similar results were also observed by Velasco *et al.*, (1994). Trials with complete blocks, or to supplement poor hay or straw, gave scarce performances (10.2 ± 5.1 and 9.2 ± 3.8 g/d respectively). This was probably due to the excessive ingestion of soluble carbohydrates (MORISSE *et al.*, 1983) since poor forages, if administered, are ingested in a limited amount (PEREZ, 1994). On the contrary palatable forages could permit a more appropriate balance of ingesta as also observed by RAHARJO (1986). Cement percentage higher than 10 % produced too hard blocks to permit a sufficient ingestion. Only milled foodstuffs were suitable to produce good blocks. When not milled ingredients were used the excessive size of particles made the product difficult to be mixed and very light and friable.

Table 2 : Main results obtained with different block formulations

Technological conditions	Complete	Supplement: fresh forages***	Supplement: hay (or straw)
Molasses			
< 45 %	- Breakable (excessive losses)	- Breakable (excessive losses)	- Breakable (excessive losses)
45 - 50 %	- good hardness (no losses) - good palatability - reduced intake - softened faeces - scarce performances (ADG 10.2 ± 5.1 g/d)	- good hardness (no losses) - good palatability - good performances (ADG 31.0 ± 9.3 g/d)	- good hardness (no losses) - good palatability - excessive block *vs.* hay ingestion - softened faeces - scarce performances (ADG 9.2 ± 3.8 g/d)
Cement *			
2 -4 %	- not evident effect	- not evident effect	- not evident effect
> 10 %	- not tested	- very hard - very scarce ingestion	- not tested
Particle size			
Milled (or small particles)	- good hardness - good density	- good hardness - good density	- good hardness - good density
Non milled (chopped straw**)	- formulation problems	- too light - friable	- too light - friable

* in addition to molasses.
** Only technological test of manufacturing have been performed.
*** Mainly alfalfa or alfalfa with graminaceous not exceeding 25 %.
ADG = average daily gain.

Hindrances to formulate complete blocks were overcame with crumbles (Table 3) which needed only 10-15 % of molasses. Cement (2-4 %) and starch from wheat flower (10-12 %) were useful in addition to molasses. Sufficient growing performances with complete crumbles (25.8 ± 6.9 g/day) or with crumble supplementing poor forages as hay or straw (22.4 ± 5.2 g/day) were obtained. Suitable results were obtained utilising milled ingredients or flower. When alfalfa leaflets were introduced some formulation problems emerged and a rather light but a still suitable product was obtained.

Table 3 : Main results obtained with different crumble formulations

Technological conditions	Complete	Supplement	
		fresh forages***	hay (or straw)
*Molasses**			
10 - 14 %	- no losses - sufficient performances (ADG 25.8 ± 6.9 g/d)	- not yet tested	- no losses - sufficient performances (ADG 22.4 ± 5.2 g/d)
> 15 %	- not tested - supposed molasses excess	- not yet tested	- not yet tested
Particle size			
Milled (or small particles)	- suitable particles - no powder	** - suitable particles - no powder	- suitable particles - no powder
Non milled (alfalfa leaflets)	** - formulation problems	** - rather light - enough suitable	- rather light - enough suitable

* In addition to 2-4 % cement and 10-12 % starch from wheat flower.
** Only technological test of manufacturing have been performed.
*** Mainly alfalfa or alfalfa with graminaceous not exceeding 25 %.
ADG = average daily gain.

CONCLUSIONS

Manufacturing of blocks and crumbles are simple technologies that allow the utilisation of local feedstuffs and by-products in integrated mixtures for rabbits raised in Developing Countries. Also a small industrial production is possible. Blocks, having a high molasses concentration, can be successfully used only to supplement fresh forages based diets. These are ingested in a sufficient amount able to reduce the negative effect of the high molasses content. To obtain complete feedstuffs, or to supplement poor forages, it is necessary to prepare crumbles which need a reduced amount of molasses. Crumbles make it also easier to include alfalfa hay leaflets.

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Técnicas no-convencionales de alimentación de los conejos en los Paises en Desarrollo - Se han estudiado las condiciones de formulación de bloques y de piensos desmenuzados para permitir la utilización de recursos alimenticios locales en los Paises en Desarrollo. Como conglutinantes y para reducir el polvo se han utilizado melaza y cemento. Los ensayos se han efectuado con conejos al engorde de diferente etad (35, 60 y 70 días). Se han considerado los factores favorables y desfavorables a la preparación de los alimentos compuestos y en relación con los crecimientos obtenibles. Buenos crecimientos riferibles a la situación rural (31.0 ± 9.3 g/d) se han obtenido con bloques al 45-50 % de melaza para suplementar forrajes frescos. Pero cuando los bloques fueron usados solos o para suplementar forrajes pobres los resultados fueron escasos (10.2 ± 5.1 g/d y 9.2 ± 3.8 g/d respectivamente), debido a la excesiva ingestión de melaza. Estas condiciones limitantes fueron superadas con la preparación de pienso desmenuzado que necesita una cantidad más reducida de melaza (10-15 %) y por lo tanto puede ser consumido solo o para suplementar forrajes pobres. En estos ensayos se han conseguido crecimientos de 25.8 ± 6.9 y 22.4 ± 5.2 g/d respectivamente.