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EFFECT OF HUMIDITY AND PARTICLE SIZE ON BARLEY AND BEET PULPS PALATABILITY IN DAIRY GOATS

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SUMMARY

The purpose of the present study was to know whether dry and humid feeds of the same composition with different size of particles had the same palatability for dairy goats. So, the palatability of 2 feeds barley and beet pulps was tested at 10, 40 and 70 % humidity and with fine, average and coarse particles.

Goats refuse feeds with very fine size of particles totally or partially. With fine particles, goats preferred beet pulps with high humidity but with coarse particles, goats had no preference for coarse or fine particles. Close results were observed on barley. It appeared an interaction between the effects of particle size and humidity on feed palatability.

Keywords : Goats, palatability, beet pulp, barley, humidity, particle size

INTRODUCTION

Goats are very sensitive to the palatability of feeds, particularly of concentrates (MORAND-FEHR *et al* 1991). They can refuse concentrate of low palatability totally or partially. At the present time, the problem is very important because more and more frequently, compound concentrates contain feeds of low palatability such as rapeseed oilmeal, fat, meat meal, urea etc.. (MORAND-FEHR *et al* 1985, MORAND-FEHR and HERVIEU 1988).

On the other hand, complete feeds (mixture of forages, grains, oilmeals and agricultural by-products) are more and more used in dairy goats (HERVIEU and MORAND-FEHR 1994). They must be humid (30-55 % water) to be efficient.

The purpose of the present experiment was to know whether a dry or humid feed of the same composition had the same palatability for dairy goats. As the capacity of water absorption is different in a feed rich in starch or fiber and according particle size, two different feeds were used in this experiment barley rich in starch and beet pulp rich in fiber, grinded coarsely or finely.

MATERIAL AND METHODS

The accurate conditions of tests to discriminate palatability differences in dry concentrate feeds were defined by MORAND-FEHR *et al* (1987). The tests are lightly modified for humid feeds (MORAND-FEHR *et al* HERVIEU 1993).

Animals were accustomed during 4 weeks before the beginning of tests. They tests took place in special crates where each goat was free to eat or not. Tests began at 11.00 am when goats were lightly hungry but not too much, 4 hours after the last meal. Four boxes containing 200 g dry or humid feed were presented to each goat during a sequence of 4 x 30 secondes by opening and closing trough shutters. Two boxes contained Feed 1 and the two other ones contained Feed 2. The position of boxes in the trough changed during each 15 second trough closing to avoid position habits.

Each test was carried out by testing 2 feeds simultaneously. When the palatability of three feeds 1, 2, 3 must be estimated in a test series, three tests were carried out by comparing each possible couples of feeds : 1-2, 1-3, 2-3 average quantity ingested in all the tests of the series where feed 1 was present.

In this experiment, 16 Alpine or Saanen goats in mid lactation were selected on the repetitiveness of results and to discriminate feed palatability. They were used in 11 series of 3 tests ; everyone carried out in a latin square design.

Two feeds barley and deshydrated beet pulps were grinded with 1 and 5 mm screen. Three sizes of particles were obtained : fine (F) going through 1 mm screen, average (A) through 5 mm screen and coarse (C) being not able to go through 5 mm screen. Three humidities were tested : Dry 10 % humidity (D), 40 % humidity (H40) and 70 % humidity (H70).

Dry feeds H40 and H70 were grinded and afterwards humidified with 30 % and 60 % water before being screened through 5 and 1 mesh screens.

Here is the list and characteristics of feeds tested :

| Name | Feed | Humidity | Particle size |
|-------|------------|------------|---------------|
| PFD | Beet pulps | Dry 10 % | Fine |
| PFH40 | - | Humid 40 % | - |
| PFH70 | - | Humid 70 % | - |
| PAD | - | Dry 10 % | Average |
| PAH40 | - | Humid 40 % | - |
| PAH70 | - | Humid 70 % | - |
| PCD | - | Dry 10 % | Coarse |
| PCH40 | - | Humid 40 % | - |
| PCH70 | - | Humid 70 % | - |
| BFD | Barley | Dry 10 % | Fine |
| BFH40 | - | Humid 40 % | - |
| BFH70 | - | Humid 70 % | - |
| BAD | - | Dry 10 % | Average |
| BAH40 | - | Humid 40 % | - |
| BAH70 | - | Humid 70 % | - |
| BCD | - | Dry 10 % | Average |
| BCH40 | - | Humid 40 % | - |
| BCH70 | - | Humid 70 % | - |

Unfortunately barley composed of fine particles (BF) became pasty where water was added and did not keep an particle structure. Consequently 8 series of 3 tests were carried out according a latin square design and 3 series of one test to compare each feed at the same humidity and with different particle size, and at the same particle size with different humidity.

| | | |
|-------|----|---|
| Serie | 1 | 3 tests : PFD-PAD, PFD-PCD, PAD-PCD |
| | 2 | 3 tests : PFH40-PAH40, PFH40-PCH40, PAH40-PCH40 |
| | 3 | 3 tests : PFH70-PAH70, PFH70-PCH70, PAH70-PCH70 |
| | 4 | 1 test : BAD-BCD |
| | 5 | 1 test : BAH40-BCH40 |
| | 6 | 1 test : BAH70-BCH70 |
| | 7 | 3 tests : PFD-PFH40, PFD-PFH70, PFH40-PFH70 |
| | 8 | 3 tests : PAD-PAH40, PAD-PAH70, PAH40-PAH70 |
| | 9 | 3 tests : PCD-PCH40, PCD-PCH70, PCH40-PCH70 |
| | 10 | 3 tests : BAD-BAH40, BAD-BAH70, BAH40-BAH70 |
| | 11 | 3 tests : BCD-BCH40, BCD-BCH70, BCH40-BCH70 |

RESULTS AND DISCUSSION

At the same humidity, goats preferred beet pulps with coarse particles (table 1). Only at 70 % humidity, beet pulps with average and coarse particles had close palatabilities. With barley, the differences between average and coarse particles are only significant with dry barley (table 2). With dry barley, goats preferred coarse particle feed but with 70 % humid barley, the palatabilities of coarse and average feeds were very close as with beet pulps.

With the same particle size, the results on barley and beet pulps were different (table 3 and 4). With fine particles, beet pulps with high humidity (70%) were preferred by goats as much on raw matter than on dry matter. The same trend was observed on average particle beet pulps with raw matter basis but no difference was significant with raw matter basis but no difference was significant on raw matter basis but goats ingested more dry matter when barley was presented dry or 40 % humid. With coarse particles, goats have no preferences for different water contents in the case of barley and beet pulps but they ingested more dry matter of barley (significantly) and beet pulps (unsignificantly) when they were presented dry or with 40 % humidity.

So, goats preferred feeds with coarse particles to fine particles. These results was observed as much with dry feeds than with humid feeds. The coarse particles feeds tended to be preferred to average particle feeds but this effect slowed down when humidity of feeds increased.

If we compared feed palatability according their humidity with a comparison basis of raw matter, goats preferred very humid beet pulps particularly with fine particles. The difference were not significant with average and coarse particles. In the case of barley, the very humid feed was the less acceptable insignificantly and with comparison basis of dry matter significantly. At 70 % humidity the capacity of barley to absorb water was reached. The palatability of very humid barley (BAH70 or BCH70) decreased because goats do not like feeds presenting unabsorbed water as we observed in previous experiments. In conclusion, the effects of granulometry on palatability are important and do not depend on kind of feeds. The effects of humidity would depend on the capacity of water retention of each feed.

CONCLUSION

The results clearly showed that goats refused fine or very fine particle sized feeds totally or partially what supports the observation of MERWE et Mac DONALD (1973) and SUZUKI *et al* (1980) on cattle. The effect of granulometry would not be linked to the kind of feeds. On the contrary, the effects of humidity would depend on water retention capacity of feeds and particularly the proportion and nature of starch and fibre fractions. Indeed goats would refuse feeds with unabsorbed water superficially and with not water enough to agglomerate fine particles. So, it appears an interaction between the effects of particle size and humidity on feed palatability.

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Table 1. Effect of particle size on palatability of beet pulps

| Serie 1 | Dry beet pulps | | |
|------------------------|----------------------------|-----------------------|-----------------------|
| | PFD | PAD | PCD |
| Palatability g R.M.* | 1.0 (1.7) ^a *** | 82 (69) ^b | 138 (94) ^b |
| Palatability g D.M**.* | 0.9 (1.5) ^a | 74 (62) ^b | 125 (84) ^b |
| Serie 2 | 60 % DM beet pulps | | |
| | PFH40 | PAH40 | PCH40 |
| Palatability g R.M. | 0.9 (2.3) ^a | 109 (68) ^b | 221 (73) ^c |
| Palatability g D.M*. | 0.5 (1.4) ^a | 66 (41) ^b | 133 (44) ^c |
| Serie 3 | 30 % D.M. beet pulps | | |
| | PFH70 | PAH70 | PCH70 |
| Palatability g R.M. | 4.3 (8.2) ^a | 242 (72) ^b | 274 (69) ^b |
| Palatability g D.M. | 1.3 (2.5) ^a | 73 (22) ^b | 82 (21) ^b |

* R.M. raw matter, **D.M. dry matter, *** Mean, () Standard error, two different subscripts in the same line means a significant ($P \leq 0.05$) difference.

Table 2. Effect of particle size on palatability of barley

| Serie 4 | Dry barley | |
|---------------------|-----------------------|------------------------|
| | BAD | BCD |
| Palatability g R.M. | 93 (62) ^a | 224 (60) ^b |
| Palatability g D.M | 84 (56) ^a | 202 (54) ^b |
| Serie 5 | 60 % D.M. barley | |
| | BAH40 | BCH40 |
| Palatability g R.M. | 191 (56) ^a | 247 (76) ^a |
| Palatability g D.M. | 115 (34) ^a | 148 (46) ^a |
| Serie 6 | 30 % D.M. barley | |
| | BAH70 | BCH70 |
| Palatability g R.M. | 253 (84) ^a | 273 (112) ^a |
| Palatability g D.M. | 76 (25) ^a | 82 (34) ^a |

Table 3. Effect of water content on palatability of beet pulps

| Serie 7 | Fine particle beet pulps | | |
|---------------------|-----------------------------|-----------------------|-----------------------|
| | PFD | PFH40 | PFH70 |
| Palatability g R.M. | 4.8 (9.2) ^a | 41 (34) ^b | 168 (81) ^c |
| Palatability g D.M | 4.3 (8.3) ^a | 25 (20) ^b | 50 (24) ^c |
| Serie 8 | Average particle beet pulps | | |
| | PAD | PAH40 | PAH70 |
| Palatability g R.M. | 58 (62) ^a | 168 (59) ^b | 218 (64) ^b |
| Palatability g D.M. | 52 (55) ^a | 101 (36) ^a | 65 (19) ^a |
| Serie 9 | Coarse particle beet pulps | | |
| | PCD | PCH40 | PCH70 |
| Palatability g R.M. | 123 (86) ^a | 147 (70) ^a | 219 (76) ^a |
| Palatability g D.M. | 111 (77) ^a | 88 (42) ^a | 65 (23) ^a |

Table 4. Effect of water content on palatability of barley

| Serie 10 | Average particle barley | | |
|---------------------|-------------------------|-----------------------|------------------------|
| | BAD | BAH40 | BAH70 |
| Palatability g R.M. | 193 (77) ^a | 243 (75) ^a | 177 (108) ^a |
| Palatability g D.M. | 174 (69) ^a | 146 (45) ^a | 53 (32) ^b |

| Serie 11 | Coarse particle barley | | |
|---------------------|------------------------|-----------------------|------------------------|
| | BCD | BCH40 | BCH70 |
| Palatability g R.M. | 224 (71) ^a | 248 (72) ^a | 190 (104) ^a |
| Palatability g D.M. | 202 (64) ^a | 149 (43) ^a | 57 (31) ^b |