Determination of the Buffering Capacity of Silages

1. Principle

The pH is lowered by the addition of 0.5 M HCl. The quantitiy of 0.05 M NaOH required to change the pH from 4 to 6 is then measured.

Buffering Capacity is expressed in milliequivalents (meq) of alkali (NaOH) required to change the pH of 1 kg DM from 4 to 6. Most of the buffering properties of herbage can be attributed to the anions present (organic acid salts, orthophosphate, sulphates, nitrates and chlorides), with plant protein accounting for 10 to 20 % of the buffering. During ensiling of grass, the buffering capacity of the material increases (3-4 fold increase) as a result of the formation of fermentation acids.

2. Apparatus

2.1 Analytical balance, reading 0.0001 g
2.2 Metrohm 670 Titroprocessor
2.3 2 x 665 Dossimats (20)
2.4 Metrohm plastic beakers
2.5 Metrohm brown glass beaker, part no. G1432.323
2.6 Printer paper, part no. 6.2237.00/MET
2.7 1 ml pipette – calibrate by carrying out regular checks (by weight)
2.8 100 ml Dispenser

3. Reagents

3.1 0.5 N HCl
3.2 0.05 N NaOH
3.3 De-ionised water

4. Samples

The analysis is carried out on dried forage.

5. Procedure

1. Weigh approximately 1 g of sample into a beaker (2.4). Record the weight.
2. Add 80 ml of de-ionised water. Leave to stand for at least half an hour.
3. Fill the dossimats with reagents: 0.5 N HCl in left dossimat, 0.05 N NaOH in right. Set delivery rate at 5. Fill the water container with de-ionised water.
4. Check the normality of NaOH as follows:

– Add 1 ml of 0.5 N HCl to a plastic beaker (x 3). Accuracy here is important – use calibrated pipette (2.7)

- Add in 80 ml of de-ionised water using dispenser (3.8)
- Ensure that the reagent bottles and the water tank are full, procedure for priming dossimats (only if there are air bubbles or when inserting a new dossimat)
- Place the 3 beakers on the carousel, followed by brown glass beaker (3/4 fill with de-ionised water)
- Start the analysis by following the procedure given on the instrument (see note 1)
- If satisfactory, take the average of the three results and write on to analysis form. If the normality is not correct then discard both solutions, re-fill and re-check.

5. Place the sample beakers on the carousel. Choose the appropriate programme to run analysis. Place the brown glass beaker at the end of the run (3/4 full of de-ionised water).
6. Check the levels of reagents and water periodically. The instrument may be run overnight.
7. Place the pH electrode in storage solution when not in use. The plug on the probe should be closed when not in use and unplugged when in use.

6. Calculation

Dry forage

B.C. = Normality of NaOH x titre x 1000 x 1.12/sample weight where 1.12 is used to allow for an average Dry Matter of 89 % (milled, dried forage).

7. Repeatability

A difference of 50 meq/kg DM is acceptable for replicate testing of samples.

MUCK *et al.*, 1991; PLAYNE and McDONALD, 1966

Reference List

MUCK, R.E., O´KIELY, P. and WILSON, R.K. (1991): Buffering capacities in permanent pasture grasses. Irish Journal of agricultural Research, 30, 129-141.

PLAYNE, M.J. and MCDONALD, P. (1966): The buffering constituents of herbage and of silage. Journal Science Food Agriculture, 17, 264-268.