

rations is not easy. However, it is important for you to understand how to measure their quality. The most common measures are of protein and energy. Protein is measured in crude protein units, an estimate of the total protein content of the feed. A common measure of energy is metabolizable energy units, which measure the amount of useful energy the feed contains. The amount of calcium in the ration for milking animals is also an important measure of quality. Farmers who would like to use these measures should get information from more technical literature or seek advice from a livestock services provider.

## How can I make concentrates at home?

- Have a list of all available feed ingredients (see table 1).
- Group the ingredients according to availability of the macronutrients (energy, protein, minerals). The general rule where a weighing scale is not available is to mix the energy (the cereals) and the protein feeds (the oilseed cakes + leaf meals) at the proportion of 3 to 2. Use minerals and premixes such as lysine in small amounts as shown in table 2. For mineral sources not listed in the table, seek information from advisory services.
- Identify a good, clean mixing area. Farmers with a herd of 5 or more milking cows can acquire feed mixers with outputs as little as 500 kg per hour from manufacturers of machines for small industries.
- If you are mixing manually, start mixing the ingredients being used in small proportion—for example, mix the salt + mineral then add the yeast. Mix thoroughly, using a clean shovel.
- Continue mixing with the shovel to ensure that all ingredients are distributed well throughout.
- Store your mixed feed well. Gunny bags are commonly used.

## How do I feed concentrates to my animals?

The best way to feed concentrates to dairy animals is to base the feeding on milk production. Feed concentrates either by giving the same rate throughout lactation or by challenge feeding. In challenge feeding, give the cow a low level of concentrate at calving and increase it gradually until further increase does not result in increased milk. Targeted concentrate feeding in the latter method has been shown to increase net returns for some smallholder dairy farmers in Kenya. Findings from the Kenya smallholder dairy project have shown that most farmers feed 2 kg of concentrate per cow per day and get 5–7 litres of milk. When this amount was raised to 8 kg of concentrate per day for a targeted period the total milk yield increased by 24%.

## How much concentrate to feed?

The amount of concentrate to feed depends mainly on two factors: quality of the forage and milk production level of the cow. Other factors can include weight of the cow and availability of either forages or the concentrate. A general rule on feeding concentrate suggests 1 kg of concentrate for each 2–3 litres of milk. Table 3 gives a rough guide on expected milk yields for poor-, medium- and high-quality forage and amount of concentrate to feed a mature cow weighing 350–500 kg.

**Table 3.** Expected milk yields at different concentrate feeding levels with poor- to high-quality forage

| Quality of forage                                     | Concentrate (kg/day) | Milk yields (kg/day) |
|---|----------------------|----------------------|
| Poor quality (crop residues)                          | 0                    | 0                    |
|   | 3                    | 2–5                  |
|   | 6                    | 6–10                 |
|   | 10                   | 10–20                |
| Medium quality (mature hay + legume forage)           | 0                    | < 5                  |
|   | 3                    | 5–10                 |
|   | 6                    | 10–18                |
|   | 10                   | 18–25                |
| High quality (good hay/ Napier grass + legume forage) | 0                    | 8–12                 |
|   | 2                    | 12–20                |
|   | 6                    | 20–30                |
|   | 10                   | > 30                 |

## Practical experience from Uganda

Table 4 gives ingredients and chemical composition of a simple dairy meal of about 16% crude protein, used in a Kampala peri-urban area in Uganda.\*

You can save over 30% of the total cost by mixing your own concentrate.

### Advantages of homemade rations

- You can increase animal production in remote areas where commercial rations are not available.
- You can increase farm efficiency by using on-farm by-products.
- You can reduce the cost of production where homemade rations are cheaper than commercial rations.
- Your feed is fed fresh and is of good quality.



**Table 4.** Proportions (kg/100 kg DM) and price per kilogram of components in a homemade concentrate

| Ingredient             | DM (%) | CP (% DM) | Proportion in mixture (kg) | CP contribution (%) | Av. price (UGS/kg) | Total cost (UGS) |
|------------------------|--------|-----------|----------------------------|---------------------|--------------------|------------------|
| Maize bran             | 83.8   | 10.7      | 82.0                       | 8.8                 | 150                | 12,300           |
| Cotton seed cake       | 93.6   | 45.2      | 17.0                       | 7.7                 | 300                | 5,100            |
| Maclick mineral powder | —      | —         | 1.0                        | —                   | 1,700              | 1,700            |
| Total                  | —      | —         | 100.0                      | 16.5                | —                  | 19,100           |

The mineral powder, obtained from market, contained the following minerals with the percentage contribution of each given in brackets: Ca (18.51), Co (0.02), Cu (0.10), Fe (0.5), Mg (3), Mn (0.4), Mo (0.002), NaCl (27), P (11), S (0.4), Zn (0.5); Ca : P ratio of 1.68 : 1.

DM – dry matter; CP – crude protein; UGS – Uganda shilling, valued at UGS 1920 to USD 1 at the time the table was compiled.

### Disadvantages of homemade rations

- It is not easy to maintain quality control and balance the ration because some ingredients may not be available.
- Due to variability in quality it is difficult to determine feeding rates.
- It is difficult to mix homogeneously, especially the ingredients used in small amounts, because mixing is done manually.
- It is difficult to observe recommended limitations for some ingredients, which can be toxic or have negative effects.

### For more information

To mix quality homemade dairy concentrate you need good information on feed quality and animal nutritional requirements. Seek information from livestock service providers. Here are sources of more information in Kenya, Rwanda and Uganda:

**EADD Kenya Country Office**  
Elgon View  
PO Box 5201 – 30100, Eldoret, Kenya  
Tel: +254 (0)53 203 1273/8  
Mobile: +254 (0)715 783 045  
Email: info@eaddairy.org

**EADD Uganda Country Office**  
Plot 14, Lourdel Road, Nakasero  
PO Box 28491, Kampala, Uganda  
Tel: +256 (0)414 233 481  
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Email: eadd.info@eaddairyuganda.org

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**EADD leaflet no. 6**



Markets for making homemade concentrates are growing in the rural areas

# Mixing and feeding homemade dairy concentrates

This leaflet tells you how to mix a dairy concentrate at home and how to use such a concentrate. It emphasizes how important these concentrates are.

## What are concentrates?

Concentrates are mixtures of commercial feeds, such as dairy meal, cubes and pellets, and individual ingredients, such as the milling by-product wheatfeed, maize germ meal and cottonseed cake. Concentrates are mainly sources of energy and protein, but they usually also contain minerals and other important nutritional requirements that cannot be met from forage alone.

Concentrates are rich in nutrients—energy or protein or both. They provide far more nutrients than an equivalent weight of forage. They are low in fibre and their dry matter content is usually high. In dairy production, concentrate mix is always used to supplement a basal diet, which is normally forage.

## Why feed concentrates?

Present-day high-producing cows are the result of years of genetic improvement programmes. Now, however, poor feed, inadequate in both quality and quantity, is a major constraint in efforts to improve the productivity of livestock in many smallholder production systems in East Africa, whether mixed farming, pastoral or agropastoral. The principal sources of feed for ruminants in mixed crop–livestock systems are crop residues complemented with forage collected from communal land, forests, roadsides or fallow land, or by grazing animals on those lands. This feeding regime often does not meet the nutritional requirements for maintaining high milk production of dairy cows. Adding a supplement of concentrates helps meet the high demand for nutrients needed to assure top milk production.

Dairy animals require nutrients for maintenance, growth, foetus development and milk production. Just what each animal needs depends on its physiological state. Forages, the basic diet of ruminants, do not contain sufficient nutrients and minerals to meet the feed requirements for dairy animals, especially for high milk production. Concentrates, rich in the nutrients that are deficient in forages, balance the diet.

Concentrates also improve intake of forages especially when the forage is of low quality, which is usually the case in smallholder production systems of East Africa. But too high a proportion of concentrates in the diet interferes with rumen fermentation and decreases digestion efficiency



*Feeding dairy concentrate optimize the genetic potential of a good dairy cow.*

## What is in a dairy concentrate?

Concentrates contain high-energy feedstuffs that are added to a ration primarily to increase its energy density. They are mostly cereals or cereal by-products, roots and tubers, liquid feeds like molasses, fats and oils. However, these energy sources also contain small quantities of other nutrients—proteins, minerals and vitamins. The energy is in the form of starch, with a crude protein content of 8–12%, high in phosphorus but low in both crude fibre and calcium.

Concentrates also contain protein supplements, defined as feedstuffs that contain more than 20% crude protein on the basis of dry matter. All the energy sources named here also supply protein but usually not in quantity enough to meet the animal's requirements. Plant protein sources are mainly oilseed meal or leguminous forages; animal protein sources are mainly fishmeal and meat or bone meal. However, the outbreak of mad cow disease or bovine spongiform encephalopathy (BSE) led to a ban on using animal protein other than fishmeal as livestock feed.

Minerals make up a small portion of the diet but make a major functional contribution. Generally, because their content in the main diet is inadequate for high-producing dairy cows, mineral supplementation is necessary. The amount of supplementation depends on the mineral content of the main diet. The mineral level in plant feed in turn depends on the mineral content of the soil. As much as possible, the main diet should meet basic mineral requirements. Individual requirements depend on the age of the dairy cow and her level of production.

Table 1 shows potential ingredients for formulating a concentrate in East African smallholder dairy systems and quality of the nutrient.

**Table 1.** Common feed ingredients for homemade dairy concentrates in East Africa

| Ingredient                  | Energy   | Protein (CP %) <sup>a</sup> | Ash (mineral) |
|-----------------------------|----------|-----------------------------|---------------|
| Commercial dairy meal       | high     | high                        | high          |
| Broken whole grain maize    | high     | moderate                    | low           |
| Maize bran                  | moderate | moderate                    | low           |
| Maize gluten feed           | high     | high                        | low           |
| Wheatfeed                   | high     | moderate                    | low           |
| Wheat bran                  | moderate | moderate                    | low           |
| Cassava meal                | high     | low                         | low           |
| Cassava pulp, waste         | moderate | low                         | low           |
| Sweetpotato tubers          | high     | high                        | high          |
| Molasses                    | high     | low                         | low           |
| Coffee hull, pulp           | moderate | moderate                    | moderate      |
| Brewers grain waste         | high     | moderate                    | low           |
| Cottonseed cake             | moderate | high (23–35%)               | moderate      |
| Sunflower seed cake         | moderate | high                        | moderate      |
| Simsim seed cake            | moderate | high                        | moderate      |
| Copra cake (coconut)        | moderate | high                        | moderate      |
| Groundnut cake              | moderate | high                        | moderate      |
| Crushed legume grains       | moderate | high                        | moderate      |
| Kapok cake                  | moderate | high                        | moderate      |
| Lime                        | —        | —                           | high          |
| Fodder shrub leaf meal      | low      | high                        | low           |
| Herbaceous legume leaf meal | low      | high                        | low           |
| Blood meal                  | low      | high                        | low           |
| Fishmeal                    | moderate | high                        | high          |
| Bone meal                   | —        | high (85%)                  | high          |

<sup>a</sup> CP – crude protein: low < 9%, moderate 9–18%, high > 18%

## Concentrate feeding in smallholder dairy production systems

Concentrates are expensive and where there is no enforced regulation on animal feed standards, returns to commercial concentrate feeding could be negative. However, in a smallholder production system, homemade dairy concentrates are a good way to reduce the costs of concentrate feeding. Homemade concentrates can make use of available farm produce. Most of the ingredients listed in table 1 are available to smallholder

dairy farmers. Table 2 shows different combinations of common ingredients used to produce homemade concentrates. Combined ingredients for each formula produce 100 kg. The most common commercial concentrate in the region is dairy meal, which has a crude protein level ranging between 15% and 18%. The crude protein content of concentrate mix depends on the quality and amount of the ingredients used in formulating the mixture.

**Table 2.** Homemade dairy concentrates (all measures in kg)

| Ingredient   | Formula 1 | Formula 2 | Formula 3 | Formula 4 |
|--|-----------|-----------|-----------|-----------|
| Maize bran, wheat bran                                 | 35.0      | 20.0      | 48.5      | 75.0      |
| Rice polishing   | 15.0      | 20.0      | —         | —         |
| Sunflower, cotton, kapok cake                          | 18.0      | 32.0      | 16.0      | 12.0      |
| Groundnut, coconut, simsim, palm kernel cake           | 6.0       | 20.0      | —         | —         |
| Yellow gram (chickpea)                                 | 15.0      | —         | 20.0      | —         |
| Fodder tree, herbaceous legume meal (such as leucaena) | 4.0       | —         | 10.0      | 10.0      |
| Limestone, bone meal                                   | 3.0       | —         | 4.0       | 2.5       |
| Maclick super, cattlemix, Bayslick, superlick          | —         | 2.5       | 0.5       | —         |
| Common salt  | 0.5       | 0.5       | 1.0       | 0.5       |
| +Dry yeast   | 3.0       | 5.0       | —         | —         |
| Premixes (lysine and methionine)                       | 0.5       | —         | —         | —         |
| Total mix  | 100.0     | 100.0     | 100.0     | 100.0     |
| Crude protein %  | 12.5      | 18.6      | 18.6      | 11.5      |

## Key issues on some of the ingredients

Leaf meal from fodder tree shrubs and herbaceous legumes can substitute for oilseed meal, which is more expensive and may not be readily available

Dry yeast and premixes are not commonly used by smallholder dairy farmers, but recent developments show that these ingredients are essential for high-yielding animals. Fishmeal in dairy rations improves protein digestion efficiency and consequently increases milk production. Controlling the quality when mixing homemade