

Combining mashed cactus pear fruit with dry hay or straw to preserve it as kuilmoes

The principle of anaerobic fermentation is used when combining mashed cactus pear fruit (high water content produce) with dry, coarsely ground plant material such as crop residues or lucerne hay to preserve it as kuilmoes; a high water content livestock feed akin to conventional silage.

Background on current cactus pear fruit initiatives

Current initiatives in South Africa promote spineless cactus pear (*Opuntia ficus-indica*) as a water-efficient, multi-use crop which can be used as livestock feed, food for human consumption, to extrude high value organic seed oil for the cosmetic sector, and for a myriad of pharmaceutical and medicinal applications.

Cactus pear is well adapted to dry areas; also known as prickly pear, it is used as livestock feed during recurring droughts. In an initiative at the University of the Free State (UFS), South Africa, coarsely ground, sun-dried cladodes are included in balanced diets for ruminants. The initiative at the UFS was recently broadened to combine mashed cactus pear fruit with dry hay and straw and preserve it as kuilmoes; a high water content livestock feed.

Preserving mashed cactus pear fruit with dry hay and straw as kuilmoes

Spineless cactus pear fruit is produced seasonal, yielding large quantities of fruit in a relatively short period of a few months in summer. Not all fruit is suitable for human consumption, creating another opportunity to utilize a valuable component of the high yielding cactus pear as livestock feed. Unless kept in cold storage, the fruit cannot be stored for a long period. Therefore, a procedure was developed to combine large volumes of mashed cactus pear fruit with dry hay and straw and preserve it for longer periods as high moisture livestock feed, kuilmoes; a high water content livestock feed similar to silage.

In short: silage is high water content forage for ruminant livestock, stored in the absence of oxygen and preserved by organic acids produced during fermentation. Ideally a crop such as maize is ensiled when it contains about 30-35% dry matter (DM). Bacteria ferment sugars in the plant during ensiling to produce organic acids (primarily lactic acid) that lower the pH of the silage to levels that inhibit the growth of undesirable organisms. Once the pH drops to 4.0 or below, the silage becomes stable and growth of undesirable microbes is prevented. As long as air is kept out the silage remains preserved, because spoilage-causing yeasts in silages remain dormant in the absence of oxygen.

The principle of anaerobic fermentation is used when combining mashed cactus pear fruit with its high water content with dry, coarsely ground plant material such as crop residue or lucerne hay to preserve it as kuilmoes. The unique name “kuilmoes” is derived from a combination of the two Afrikaans words “kuilvoer” for silage and “moes” for mashed fruit.

Cactus pear fruit is mashed in a large blender, designed to mash large volumes of fresh fruit. The mashed fresh fruit, consisting of peel, pulp and seeds, contains about 37% DM. The mash is then added by weight (in the ratio of 5:1) to the available dry, coarsely ground, crop residue or hay.

In the trials at the UFS, it was convenient to combine the mashed cactus pear fruit with dry, coarsely ground wheat straw, maize hay and lucerne hay. The hay and straw were ground in a hammer mill to pass a 25 mm sieve



Fresh cactus pear fruit being fed into the hopper of a large blender to be mashed



Mashed cactus pear fruit pouring from a blender; ready to be mixed with dry, coarsely ground crop residue

Once the cactus pear fruit is mashed and exposed to air, the mash tends to increase in viscosity and become stickier and stringy; ostensibly because of the gelling nature of mucilage. The mashed cactus pear fruit is then mixed thoroughly with the dry, coarsely ground hay or straw and stored in airtight containers.



Mashed cactus pear fruit being mixed by hand with dry, coarsely ground wheat straw before being stored in airtight plastic bags

Thick plastic bags are easy to handle and the bags can be tightly bound closed with twine to exclude air. However, any corrosion resistant container may be used for this purpose, provided air is effectively excluded when closed tightly to prevent secondary aerobic spoilage or rotting. The pH of the three kuilmoes types suggest that microbial fermentation was sufficient to lower pH to below 4.0 and resulted in effective ensiling and preservation as kuilmoes.

Table: The pH and composition of mashed cactus pear fruit and straw or hay after storing the kuilmoes for more than nine months

Kuilmoes type	pH	DM	OM	CP	NDF	ADF	Fat
		g/kg			g/kg DM		
Wheat straw	3.62±0.02	301.2±11.6	897.3±1.4	80.1±4.3	557.3±7.7	405.5±12.4	16.0±0.9
Maize hay	3.72±0.20	284.2±6.1	929.5±3.4	72.2±13.7	624.3±30.5	421.1±21.9	22.6±4.5
Lucerne hay	3.82±0.03	307.0±7.0	909.0±3.4	136.4±6.6	415.5±15.3	377.5±26.5	19.0±2.5

DM – dry matter; OM – organic matter; CP – crude protein; NDF – neutral-detergent fibre; ADF – acid detergent fibre.

The procedure described to produce kuilmoes, is appropriate for small to medium sized operations. However, current available technology must now be adapted or new technology created to enable production of kuilmoes at a large commercial scale on farms.

Contacts: research & development

More detail on different aspects of the versatile, multi-use spineless cactus pear is available on request from the following contacts.

Livestock nutrition – Prof. HO de Waal & Mr. Willie Combrinck, Department of Animal, Wildlife and Grassland Sciences, University of the Free State, Bloemfontein, South Africa. dewaalho@ufs.ac.za or turksvy@ufs.ac.za

Food science – Dr. Maryna de Wit, Department of Biotechnology, University of the Free State, Bloemfontein, South Africa. dewitm@ufs.ac.za

Aspects of agronomy/cactus pear resources – Dr. Herman Fouché, Agricultural Research Council, Bloemfontein, South Africa. fouchehj@ufs.ac.za