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Advisory Note on How to Feed Animals with Cassava/Tapioca Parts

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Introduction

All parts of cassava / tapioca - leaves, stem, tuber and rind - contain the compounds called cyanogenic glucosides (CNGs) viz., linamarin and lotaustralin (in the ratio 93:7), which are hydrolysed by endogenous enzyme linamarase to acetone cyanohydrin which may break down spontaneously liberating free hydrogen cyanide. Both acetone cyanohydrin and free cyanide are toxic.

Cassava cultivars can be classified as low (<50 µg/g), medium (50-100 µg/g) and high (>100 µg/g HCN eq.) cyanide varieties. Non-bitter tubers have less than 100 µg/g HCN equivalent whereas bitter fresh roots have 100-450 µg/g and very bitter roots have more than 450 µg/g HCN equivalent.

Cassava leaves contain about 10 times higher amount of CNGs than roots. The CNG content of cassava leaves decreases with increase in age of the leaves. Young emerging leaves contain highest levels (> 400 µg/g HCN eq.), mature and old leaves have 50% and 70% lower concentrations.

The rind of cassava contains several times higher cyanoglucoside content than the edible part. Irrespective of whether it is a low or high cyanide variety, the range of hydrogen cyanide equivalents in cassava rind (peel) is about 600-1000 µg/g (mg/kg) fresh wt. The linamarase activity is also very high (30-100 times higher) in leaf and rind tissues compared to the tuber. This enables faster conversion of the cyanoglucoside to free HCN, which is highly temperature-sensitive and escapes into the atmosphere at 28°C. Feeding crushed peels or leaves immediately after crushing or without proper drying is dangerous and there is a high risk of cyanide poisoning in animals.

Processing to eliminate cyanoglucosides in cassava

The acute lethal dosage of hydrogen cyanide (HCN) in most animal species is ~2 µg/g body weight. Plant materials containing ≥200 µg/g of cyanogenic glucosides are dangerous. Cassava toxicity in animals may be acute and/or chronic. Acute toxicity results from ingestion of a lethal dose and death is caused by the inhibition of cytochrome oxidase of the respiratory chain by cyanide. Where sub-lethal doses of cyanide are consumed, the inhibition of cellular respiration can be reversed by the removal of HCN by respiratory exchange or the detoxification process, where it is converted to the less toxic thiocyanate. Chronic cyanide toxicity on animals can affect both the growth and reproductive phases of development (Tewe, 1992, FAO). Excess consumption of unprocessed cassava causes poisoning. In the event of physical signs of mild cyanide poisoning, the animals are generally administered thiosulphate and sodium nitrite to detoxify the cyanide in the animal system.

Proper processing of cassava parts is very important while feeding animals. Some of the effective methods to eliminate or reduce the cyanoglucoside levels in different cassava parts are described below:

Tuber / Roots

Tuber/roots of non bitter cultivars can be fed to the animals after peeling in the raw form itself. Nevertheless, cooking in water by slowly raising the temperature (tuber pieces should not be put into boiled water) is also advisable. If bitter varieties of cassava with high cyanide contents are used, grating/pounding of the peeled tubers and sun drying is the most effective method to remove cyanoglucosides. This treatment can eliminate up to 95-99% CNGs. Such a practice is followed in the preparation of High-Quality Cassava Flour (HQF) for human consumption purpose in African countries, where cassava is a staple food.

Peeling, cutting into thin slices and cooking in large excess of water (1:5 or 1:10) for about 30 min can remove about 80% of cyanoglucosides. However, care should be taken to see that the pieces are put to water at room temperature (not boiled) and the temperature is slowly raised. This allows the enzyme to act on the cyanoglucosides (linamarase gets inactivated at 72°C) and eliminate them to the maximum extent.

Sun drying of the peeled tuber chips (10 mm thick) for about 18 hours removes more than 80% of CNGs. The thickness of tuber slices is important especially for high cyanide varieties as slow drying helps retaining the water content, which is necessary as a substrate for the linamarase enzyme. Although thin chips dry faster, retention of cyanide is more due to the faster elimination of water.

Leaves

Boiling in water (by slowly raising the temperature) or slow sun drying for 12-18 hours can remove up to 80-90% of the cyanoglucosides present in the leaves. Chopping the leaves and boiling in water for 15 minutes result in about 85% removal of CNGs. Pounding or crushing followed by boiling will eliminate more than 97% of CNGs. Branches with leaves can be slowly wilted under shade overnight (12-18 h) to remove a high percentage of cyanide and then it can be dried in sunlight and fed to animals.

Rind / Peel

Since peels contain high amounts of CNGs, it needs to be processed separately to bring down the toxic compounds to safer levels. Crushing the peels and allowing it to remain at room temperature by spreading on a mat for about 5-6 h and then completely drying the crushed peels in sunlight is the best way to remove cyanide. However, drying in oven at high temperature is not preferred as it inactivates the enzyme linamarase. Water being a substrate for the enzyme action, only slow drying facilitates removal of greater quantities of cyanide.

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