

ROOTS & TUBERS

STRAWS & CHAFF

ROOTS AND TUBERS

Roots and Tubers

- High moisture feeds (75-94%),
- They store the nutrients in their roots or within the branches under the soil.
- Rich in carbohydrates,
- Easily digestible
- Deficient in fiber and minerals

ROOTS

- High moisture content (75-94%),
- Organic matter mainly consists of sugars
- Low in fiber, crude protein and minerals (Ca, P)
- Presence of oxalic acid and acetic acid
- They include;
- Sugar beet,
- Mangels,
- Carrots and turnips.



Mangels (*Beta vulgaris* ssp *crassa*)

- Sugar content (50-80% DM). It is necessary to store mangels after harvesting as freshly harvested mangels may cause diarrhea in animals.
- It must be cleaned of impurities like soil, mud etc.
- DM 12%, CP 8%, CF 6%, ME 12.4 MJ/kg
- It can be fed to cattle up to 30 kg. Excessive feeding decreases the milk fat content and causes milk taints.
- Horses 15-20kg/day and sheep 3-4 kg/day

Sugar Beet (*Beta vulgaris* var. *Rapa*)

- a) Beet itself b) Leaves
- c) beet pulp d) beet molasses can be used as feed for animals.
- Before feeding to animals it must be cleaned of materials like soil and mud
- Leaf bottoms and beet heads should be left uncut
- High carbohydrate content may produce gas in ruminants. Thus it should be fed to animals along with other feeds
- Sugar content makes most of the dry matter. Protein is deficient and mostly present as NPN.
- Rich in K and Fe minerals
- DM 22-25%, CP 5%, CF 5%, ME 13.7 MJ/kg



- Cattle 15kg, Horse 13-18 kg, Ram 4 kg
- Feeding for longer period of time may cause *urolithiasis* in rams.

Turnip (*Brassica rapa* var. *Esculenta*)

- Two varieties are present
 - a) Brown
 - b) Yellow
- Most of the sugar is present in the form of glucose and a little is present as saccharose
- DM 9%, CP 12%, CF 11%, EE 2%, Ash 8%, ME 11 MJ/kg,
- Feeding to the cattle before milking may change the taste and odor of the milk.
- In beef cattle it negatively affects the meat taste. Thus, max feeding limit is 10 kg.
- *Glucosinolates* are present in roots as well as in leaves.
- It also contains *S-methylcysteine sulfoxide* (causes anaemia) and *free nitrate*.

Carrot (*Daucus carota* L.)

- Uneconomical, but it is rich in carotene content (520mg/kg).
- In its structure, most of the nitrogen present is in the form of protein.
- DM 12%, CP 9.0%, CF 9.0%, Ash 10%,
ME 12.5 MJ/kg.
- Cattle 10-30kg, Horse 10-20 kg, sheep 3-4 kg/day
- It improves the milk taste, gives yellow colour to the butter and improves yellowness of the egg yolk.

Carotene content of some roughages and other feeds, mg/kg DM

Fresh Timothy grass (Mix)	33-80
Legume grass (very good quality)	77-88
Legume grass (good)	40-60
Legume grass (medium)	20-30
Legume grass (bad)	9-18
Timothy grass (good quality)	20-30
Timothy grass (medium)	9-18
Silage (legume)	10-44
Corn silage (medium)	4.4-22
Yellow maize	1.8-2.2
Grains, Flour industry by-products ,Protein concentrates	0.02-0.4

Nutrient contents and energy values of some roots (DM basis)

	DM %	OM %	CP %	DOM* %	DCP* %	CF %	ME MJ/kg
Turnip	9	92	12	72	7.3	11	11.2
Mangels	18	92	8	79	6.0	4.5	12.5
Sugar beet	23	97	5	87	3.5	5.0	13.5
Carrot	12	90	9	-	-	9.0	12.5

*digestible organic matter

*digestible crude protein

TUBERS

- Rich in moisture, Higher DM content than roots
- Under the soil tubers are formed and nutrients are stored in these tubers.
- Rich in carbohydrates and easily digestible
- Poor in crude fiber and minerals
- They include
 - a) Potatoes
 - b) Sweet potatoes
 - c) Earth apple
 - d) Cassava


Potatoes (*Solanum tuberosum* L.)

- Majority of the potatoes produced are used in human nutrition. In some countries, they are grown as animal feed.
- DM 21%, CP 9%, CF 4%, EE 5%, ME 12.5 MJ/kg
- Potatoes contain 2-10 mg/100 **SOLANINE**
- Solanine is high in immature and green potatoes
- This toxicity can be reduced through steam cooking, ensiling or drying
- Cattle 15-25 kg, sheep 3 kg, horse 15 kg
- They must be cleaned properly and boiled before feeding to the horses. If cows are given too much potatoes, it makes cheese and butter making difficult.
- In cattle, they can cause digestion problems, cholic and in pregnant animals abortion may occur.

Sweet potatoes

- It is rich in carotene, DM and starch
- Poor in protein and mineral content. Most of the protein available is true protein and it is of higher digestibility
- DM 32%, CP 4% , CF 4%, ash 6%, ME 13 MJ/kg.
- Animals like eating it
- **Ipomoein** present in their roots may cause laxative effect

Earth apple (*Helianthus tuberosus* L.)

- Because of its sweetness and juicy nature, animals love eating it
 - It is similar to potatoes in external appearance
 - DM 20%, CP 7.5%, CF 3.5%, Ash 5.5%, ME 13 MJ/kg.
 - Ruminants are given after chopping. Excessive feeding may cause diarrhoea and increase the water content of milk.
-  Taste of tuberous roots of earth apple resembles to the artichoke(enginar). High content of **inulin** gives this taste.

Tapioca (*Manihot esculenta*)

- Produced in tropical areas
- Rich in energy but poor in protein
- Tubers are chopped and dried, and the flour, starch, pellets and pulp is used for commercial purpose.
- DM 37%, CP 3.5% , CF 4.3%, Ash 3%, ME 13 MJ/kg.
- *Linamarin and lotaustralin* are present in its structure. They negatively affect the feed taste, feed consumption and digestion.
- Cooking and pelleting of tubers inactivate these toxic effects.
- To the concentrate feed mixtures, Tapioca can be added up to
 - Beef cattle 50% Dairy cattle 30%
 - Poultry feed 15%

Nutrient contents and energy values of some tubers (DM basis)

	DM %	OM %	CP %	CF %	DOM* %	DCP* %	ME (MJ/kg)
Potatoes	21	95,7	9,0	3,8	79	4,7	13,3
Tapioca	37	97	3,5	4,3	83	-	12,8
Sweet potatoes	32	96,6	4,0	3,8	84	-	12,7
Earth apple	20	94,5	7,5	3,5	84	5	13,2

*digestible organic matter

*digestible crude protein