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Crop Residues and Their Treatment

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The left-over portion of the crop after the main crop is harvested for human consumption is called as crop residues.

Crop residues may be grouped under the following headings

Straws	**Stovers**	**Aerial portion of other crops**	**Others**
Wheat Paddy Oats Barley Millets	Maize Sorghum	Soyabean Groundnut Sunflower	Corn cobs Bagasse Peanut hull Rice hull

Nutritional quality of crop residues

- Low crude protein, calcium, carotene and available energy.
- High in cell wall constituents, lignin and silica
- Reduced palatability – low voluntary intake
- Low digestibility of dry matter and bioavailability of energy
- Bulky in nature
- Presence of antinutritional factors

Processing methods to improve nutritive value

Physical	**Chemical**	**Biological**	**Combination**
Soaking Grinding Steam pressure Explosion	Acid treatment Alkali treatment Use of other chemicals- ozone,	SCP production Use of cellulolytic organisms Mushroom Growth	Physico chemical Karnal process

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Irradiation Pelleting Supplementation	H_2O_2		

Physical treatment

- **Soaking** – Chopped straw is soaked in water overnight. Softens the straw leading to increased intake. Disadvantage is mould growth and loss of water-soluble nutrients.
- **Chaffing** – Decreasing particle size. Increases surface area for action of rumen microbes and hence increases digestibility.
- **Grinding** – Particle size reduced still further. (0.1 to 0.3 cm). Disadvantage is that it increases rumen flow rate, decreases retention time in the rumen leading to decreased production of acetate causing a condition of low milk fat syndrome.
- **Steam pressure** – Straw treated with Steam at pressure of 21.1 kg/cm^2 for 10 to 30 seconds. Causes rupture of ligno celluosic bonds to a certain extent and makes cellulose available for microbial action.
- **Explosion** – Chopped or ground straw is treated with steam at pressure of 22.5 kg/cm^2 for two minutes and pressure is suddenly released. Causes rupture of lingo cellulosic bonds to a certain extent and makes cellulose available for microbial action.
- **Irradiation** – Straw is treated with γ irradiation. Causes rupture of ligno celluosic bonds and makes cellulose available for microbial action.
- **Pelleting** - Particle size reduced to 0.1 to 0.3 cm and pelleted through 1-2 cm die. Retention time in the rumen increases and the disadvantage of only grinding is overcome.

Chemical treatment

- **Acid treatment** – Straw is soaked in dilute acids for a specified period of time, washed with water drained and fed to the animals. Not popular due to the corrosive action of acids. Causes rupture of ligno celluosic bonds and makes cellulose available for microbial action.
- **Alkali treatment** – Straw is treated with NaOH, NH_4OH, CaOH, KOH, and Urea. When straw is exposed to the alkali the ester linkages between lignin and cellulose /

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hemicellulose are hydrolyzed causing the cellulose / hemicellulose to be available for digestion by microbes.

NaOH treatment

- **Beckman process:** Straw is soaked for 1-2 days in dilute solution of NaOH (15-30 g / litre), washed to remove excess alkali and fed to the animals.
- **Dry method:** Straw is chopped and sprayed with NaOH 300g/ litre (170 litre / ton of straw)

Ammonia treatment:

Anhydrous form or concentrated solution used – 30 to 35 kg/ ton of straw. Straw is stacked, ammonia solution is sprayed over the straw, kept covered for 20 days and then fed to the animals. This method not only increases the digestibility of the straw it also increases the nitrogen content of it. *Disadvantage* – On opening the stack most of the ammonia is lost by volatilization. Sometimes there is formation of toxic imidazoles from reactions between ammonia and sugars which leads to dementia (Bovine bonkers).

Procedure for preparing Urea Enriched Paddy Straw

Required Materials:

1. Paddy straw - 100 kg.
2. Urea - 4 kg.
3. Water (Clean) - 65 litres
4. Spinkler

Procedure:

To enrich 100 kg of paddy straw

1. Dissolve 4 kg urea in 65 litres of water
2. Spread a polythene sheet/Gunny bag on the floor. Initially spread 5 kg of paddy straw in layers.
3. Using the sprinkler, sprinkle the prepared urea solution over the paddy straw ensuing that all the paddy straw is wet by it.
4. Similarly spread another layer of paddy straw over the first layer and repeat the sprinkling of urea solution.
5. Repeat the spreading and sprinkling for the entire 100 kg of paddy straw and heap it and cover the straw with polythene sheets to prevent the escape of ammonia

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libareted from urea. This step facilitates the breakage of lignocellulose bond by ammonia thereby releasing cellulose from lingin bondage for digestion and utilisation.

6. After 21 days the urea treated paddy straw is ready for feeding available.

Advantages:

TDN increased from 45 to 60%

CP increased from 2% to 10%

Palatability increased therefore feed intake increases.

Feeding Urea treated Paddy Straw.

- It is advisable to feed the urea treated Paddy Straw for calves above 6 months of age
- Adaptation period is required.
- The same precautions adopted when feeding NPN substances are to be followed.
- The urea enriched paddy straw, may be left in the open for 5 minutes prior to feeding in order to remove the pungent odour of urea.

Biological treatment

1. Growing cellulolytic microorganisms white rot fungi (Trichoderma viridae, Trichoderma lignorum).
2. Growing mushrooms: Straw is steam treated, packed in polythene bags, inoculated with seed material of mushroom, bag when filled with mycelia slit open to allow fruiting, after harvesting of mushrooms the spent straw is used as feed.
3. Single cell protein production: Straw is hydrolysed, steam treated, treated with ammonia, inoculated with candida utilis and incubated, after harvesting of SCP the spent straw is used as feed.
4. Enzyme treatment- pretreatment of straw with lignase
5. Preparation of silage – Straw sprayed with water, additives such as molasses added and ensiled ina silo. Nitrogen content is increased by adding urea or poultry manure.

The above treatments cause biodegradation of lignin and increases the digestibility of cellulose. They also increase the protein content of the straw.

Karnal process: Technology developed at NDRI, Karnal. Straw treated with 4%urea at moisture level of 60%. Stacked in a silo pit under cover for 30 days. A temporary loose

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brick structure constructed. Thin layer of urea treated straw spread evenly in this structure. A solution of the following composition is prepared. 60g superphosphate, 60g calcium oxide dissolved in 8 litre water. Sprinkled over the urea treated straw. Inoculated with 3% coprinus fimeratius culture. Allowed to remain for 5 days then used for feeding. Main advantage of this process is that urea a NPN compound is converted into microbial protein and degradation of lignin.

Effect of various treatments

- Increases palatability
- Increases digestability
- Certain treatments increase nitrogen or protein content
- Improves animal performance

Disadvantage

- Increase feed costCreated by NutritionAttention:
- Technology or methodology involved