ISSN: 2583-8288
Technical Article
Published on: 31.01.2025

Diseases Relating to Energy and Protein Deficiency in Livestock

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DOI:10.5281/Vettoday.14826096

Abstract

Energy and protein are the two important nutrients required by the livestock for their growth, maintenance, reproduction and lactation. When these nutrients are readily available, the animal prioritizes maintenance needs. However, deficiencies can arise due to soil depletion, climate conditions, or seasonal variations, leading to negative energy balance in the body. This imbalance can trigger various diseases, ultimately compromising the growth, reproductive health, milk production, and overall well-being of the animal.

Keywords: Energy nutrition, protein nutrition, deficiency diseases

Introduction

Animals require major organic nutrients to build and repair tissues, produce milk, and generate energy. These nutrients, including carbohydrates, proteins, and fats, provide energy through chemical reactions. In livestock, carbohydrates, mainly glucose, are the primary energy source. When energy demands exceed supply, animals catabolize stored glycogen, lipid, and protein to maintain critical functions. Excess energy is allocated to various productive purposes, such as growth, fat storage, or milk production. Proteins, composed of essential and non-essential amino acids, are vital for metabolic processes. Simple-stomached animals like pigs obtain amino acids from food protein breakdown, whereas ruminants undergo complex protein degradation and synthesis in the rumen, affecting nutrient availability.

Energy nutrition

Sources

- **Cereals**- Bajra, sorghum, maize, wheat, barley, ragi etc.
- **Cereal by-products**- Rice bran & polish, wheat bran, maize bran etc.
- **Legumes/Pulses**- Horse gram, black gram, Bengal gram, red gram etc.
- **By-products of pulses**- Chunies, husk etc.
- **Roots and tubers**- Roots of turnips, sugarbeat, carrots, sweeds, etc. and tubers of potatoes, sweet potatoes, cassava, etc

Requirements

A. For Maintenance-

Animal	TDN (g/kg metabolic body weight)	ME (Kcal/kg metabolic body weight)
Cattle & Buffalo	34	122
Sheep	27.3	98
Goat	30	98

B. For Gestation-

- **In Cattle**- 25% more TDN over and above the maintenance requirement
- **In Goat**- 50% more TDN over and above the maintenance requirement
- **In Sheep-** 50% more TDN over and above the maintenance requirement during the last 6 weeks of gestation.

C. For Lactation-

- **In Cattle- 1st lactation**- 20% more TDN & ME over and above the maintenance requirement
  2nd lactation- 10% more TDN & ME over and above the maintenance requirement
- **In Goat-** 345 gm more TDN over and above the maintenance requirement
- **In Sheep**-First 2 months requirement is twice the maintenance followed by 1.5 times the maintenance during the remaining period

Deficiency of energy

Predisposing factors

- Insufficient quantity or quality of feed
- Underfed livestock
- Crop failure
- Insect pests
- Failure to adjust the livestock population to the productivity of land
- In some cases, forage may contain a high concentration of water, which limits total energy intake

Clinical findings

i. **In young animals**- Retarded growth and delay in the onset of puberty
ii. **In mature animals**- Marked decline in milk production, shortened lactation and prolonged period of anoestrus
iii. **In pregnant beef heifers-** Underdeveloped and fragile newborns with high mortality rates during late pregnancy and inadequate colostrum production at birth
iv. **In pregnant ewes**- Abomasal impaction occurs during prolonged periods of cold weather that are being wintered on poor quality roughage
v. **In neonatal calves** – Protein-energy malnutrition in calves is often caused by feeding low-quality milk replacers with inadequate energy or indigestible non-milk proteins.

Common diseases related to energy deficiency in livestock

1. **Bovine Ketosis (Acetonemia)**
   Cause- It results from an input and output imbalance in energy metabolism. High-producing dairy animals often experience this imbalance in the first few weeks of lactation. Although dry matter intake peaks around 8-10 weeks post-calving, milk production reaches its highest point at 4-6 weeks, creating a demand that intake may not meet. Insufficient glucose precursors, such as propionate, in the diet can lead to low blood sugar, triggering gluconeogenesis and ultimately resulting in the production of ketone bodies.
   Clinical findings – Cows affected by ketosis will exhibit symptoms including loss of appetite, reduced rumen function, lethargy, decreased milk production with elevated fat content and presence of a sweet, chloroform-like odour of acetone in milk, urine, and breath.

Treatment

- **Replacement therapy with glucose** – 25 % dextrose solution (500-1000 ml), IV for 2-3 days
- **Glucose precursors**- 125-250 gm of sodium propionate or propylene glycol orally once daily for 3-5 days
- **Hormonal therapy-** Glucocorticoids like dexamethasone sodium phosphate @40 mg, IV, for 4-6 days
- **Long-acting insulin @ 200-300 U, SC**
- **Supportive therapy** – Vitamin B_{12} and cobalt preparations

Prevention and Control

- Adequate calorie intake should be provided in the early part of lactation
- Avoid fattening and adequate exercise should be provided
- Feeding of ground maize which contains polymerized glucose escapes rumen fermentation and absorbed directly in the intestine
- After calving the number of concentrates may be increased along with good quality roughages
- The ratio should contain adequate amount of cobalt, phosphorus and iodide

2. **Ovine Ketosis (Pregnancy Toxaemia)**

Cause- Undernutrition during the last two months of pregnancy, particularly in ewes carrying multiple foetuses, can lead to pregnancy toxaemia. Ewes that were well-fed earlier in pregnancy are also at risk. A metabolic deficiency in liver enzymes contributes to the development of the disease. Affected ewes have an inadequate gluconeogenic response, leading to low blood sugar, accumulation of ketones and cortisol, and an inability to meet the glucose demands of their growing foetuses.

Clinical Findings- Grinding of teeth, dullness, ataxia, drowsiness, weakness, frequent urination, trembling when exercised with final stage being complete collapse followed by death in 90 % cases.

Treatment

- To manage the situation, the viability of the foetus is first assessed. If the foetus is alive, an emergency caesarean section is recommended. However, if the foetus is dead, induction of abortion is advised.
- **Glucose therapy-** 5-7 gm of IV glucose 6-8 times a day in conjunction with 20-40 units of zinc protamine (insulin) given SC on alternate days for 3 days
- **Oral therapy-** Oral drenching of propylene glycol or glycerine @ 110 gm daily

Prevention and Control

- The body score should be maintained below 2.5 on 5.0 scale
- Provision of nutritious feed along with mineral supplement in the late gestation
- Twinning/triplets are detected by ultrasound and special care should be provided for such ewes
- **Flock monitoring** for latent pregnancy toxaemia during the last 6 weeks of pregnancy can be conducted using serum **β-hydroxybutyrate** as an indicator with concentrations of 800 µmol/L indicating adequate energy intake, 800-1600 µmol/L indicates inadequate energy intake and more than 1600 µmol/L indicating severe undernourishment

(In Goats, disease which occurs during late pregnancy is identical to Ovine pregnancy toxaemia and that occurs in lactating does resembles Bovine ketosis)

3. **Fat Cow Syndrome**

Aetiology – In late pregnancy or early lactation, dairy cattle liver metabolism is severely strained. Due to negative energy balance, the liver ramps up glucose production from non-carbohydrate sources. This triggers the mobilization of body fat to the liver, where it accumulates as triacylglycerol, leading to fatty liver.

Clinical Findings- Anorexia, weight loss, lethargy, depression, weakness, reduced milk production, progressive debilitation and weak or no rumen contractions.

Treatment

- **Fluid and electrolyte therapy** – Continuous IV infusion of 5 % glucose & multiple electrolyte solutions
- **Glucose precursors-** Sodium or calcium propionate @250-450 gm/day orally, propylene glycol@ 250 ml once daily orally for 7-10 days
- **Glucagon** – S/C injection of 15 mg/day for 14 days beginning at day 8 post-partum
- **Insulin** – Zinc protamine @ 200-300 I.U S/C twice daily promotes peripheral utilization of glucose
- **Glucocorticoids** – Prednisolone @ 200 mg IM decreases liver triglyceride
- **Vitamins-** Vit A, E, B-complex @ 6-12 gm daily

Prevention and Control

- The total daily nutrient intake must increase throughout the last trimester to meet the needs of the foetus
- An additional 6-12 gm of niacin in added in diet to reduce BHBA levels in blood and increase blood glucose
- Inclusion of 110 gm of Calcium propionate in prefresh and fresh ration
- Exercise of dry cows also appears to be helpful
- Reduce stress and blood NEFA levels associated with stress by providing a well-ventilated, clean, dry, well-bedded calving stall

4. **Baby Pig Disease (Hypoglycaemia in neonatal piglets)**

Aetiology – Hypoglycaemia in piglets is primarily caused by factors related to either the sow or the piglet. Sow-related factors include inadequate colostrum or milk production, often due to agalactia, resulting in insufficient milk supply. Piglet-related factors include difficulties with suckling and nursing. Additionally, newborn piglets typically have low blood glucose levels (30-60 mg/dl) and struggle with glucose production in the first few days of life, leading to hypoglycaemia.

Clinical Findings- Uncertain gait, loss of balance, shivering, dullness, constant weakness, feeble heart rate, sub-normal temperature, aimless movements followed by recumbency, convulsions, salivation, champing of jaw, etc

Treatment –

- Hypertonic glucose solution (20-30 %) @ 25 ml/kg body weight by IP route, repeated every 3-6 hour
- Milk supply to these affected piglets should be restored immediately, either through mother or foster mother
- Anticonvulsants should be given to piglets showing recurrent seizures
- Glucocorticoids supplementation should also be done as a supportive therapy

Prevention and Control-

- Piglets should be observed carefully during the first week of life
- Maintenance of stable environmental temperature at 32ºC helps in preventing the occurrence

Protein Nutrition

Sources-

- **Plant origin-** Oil cakes and meals (groundnut cake, soyabean meal, sesame cake/til cake, cotton seed cake, coconut cake, mustard seed cake, rape seed meal, sunflower cake, linseed meal etc)
- **Animal origin-** Meat meal, blood meal, liver residue meal
- **Marine/aquatic origin-** Fish meal
- **Avian origin-** Feather meal

Requirements

A. **For maintenance-**
- **In Cattle-** 2.84 gm DCP per Kg metabolic body weight
- **In Sheep-** 2.97 gm DCP per Kg metabolic body weight
- **In Goat-** 3 gm DCP per Kg metabolic body weight

B. **For Gestation-**
- **In Cattle-**50% more DCP over and above the maintenance requirement
- **In Sheep-** 50% more TDN over and above the maintenance requirement during the last 6 weeks of gestation.
- **In Goat-** 50% more TDN over and above the maintenance requirement

C. **For Lactation –**
- **In Cattle-1st lactation-** 20% more DCP over and above the maintenance requirement

  2nd lactation- 10% more DCP over and above the maintenance requirement
- **In Sheep-** First 2 months requirement is twice the maintenance followed by 1.5 times the maintenance during the remaining period
- **In Goat-** 45 gm more DCP over and above the maintenance requirement

Deficiency of protein

Predisposing factors – Protein deficiency often coincides with energy deficiency. Unlike pigs, ruminants don't require a dietary supply of essential amino acids due to their unique ruminal flora. These microbes can synthesize necessary amino acids from lower-quality proteins and non-protein nitrogen sources, making the amino acid composition of dietary protein less critical for ruminants.

Clinical findings

i. **In young animals-** Inferior growth rate, lack of muscle development and prolonged time to reach maturity

ii. **In mature animals-** Loss of weight and decreased milk production

iii. **In beef cattle-** Occurs most commonly in late gestation and characterized by weakness, recumbency, loss of body weight, a normal mental attitude and a desire to eat

iv. **In periparturient cows-** Calves born to cows lacking colostrum may exhibit frantic behaviour, attempting to suckle, eat dry feed,

or drink water/urine. If left untreated, both cows and calves can die within 7-10 days.

v. **In grazing sheep** – Excessive dental attrition is seen as a result of excessive ingestion of soil

Prevention and Control

- Provide nutrients according to age, pregnancy stage, production level, environmental temperature, and feed costs.
- Use body condition scoring for cattle and sheep to monitor their nutritional status.
- Regular analysis of feed supplies will assist in the overall nutritional management program.

Conclusion

Energy and protein are crucial for all bodily functions, especially those related to animal production. Inadequate energy and protein nutrition severely impairs animal health, growth, reproduction, and lactation. Many feedstuffs and forages are deficient in energy and protein, particularly for high-demanding animals like replacement heifers and lactating animals. Therefore, carefully planned energy and protein supplementation programs are vital to maintain optimal nutrition and performance in livestock.

References

Canesin, R. C., Berchielli, T. T., Messana, J. D., Baldi, F., Pires, A. V., Frighetto, R. T. S., & Reis, R. A. (2014). Effects of supplementation frequency on the ruminal fermentation and enteric methane production of beef cattle grazing in tropical pastures. *Revista Brasileira de zootecnia*, *43*, 590-600. https://doi.org/10.1590/S1516-35982014001100005

Esposito, G., Irons, P. C., Webb, E. C., & Chapwanya, A. (2014). Interactions between negative energy balance, metabolic diseases, uterine health and immune response in transition dairy cows. *Animal reproduction science*, *144*(3-4), 60-71. https://doi.org/10.1016/j.anireprosci.2013.11.007

Hess, B. W., Moss, G. E., & Rule, D. C. (2008). A decade of developments in the area of fat supplementation research with beef cattle and sheep. *Journal of Animal Science*, *86*(14): E188-E204. 10.2527/jas.2007-0546

Huffman, C. F., & Duncan, C. W. (1944). The nutritional deficiencies in farm mammals on natural feeds. *Annual Review of Biochemistry*,*13*(1): 467-486 10.1146/annurev.bi.13.070144.002343

McMichael, A. J., Powles, J. W., Butler, C. D., & Uauy, R. (2007). Food, livestock production, energy, climate change, and health. *The lancet*, *370*(9594), 1253-1263.

Rasby, R. J., & Funston, R. N. (2016). Invited review: Nutrition and management of cows: Supplementation and feed additives. *The Professional Animal Scientist*, *32*(2): 135- 144. https://doi.org/10.15232/pas.2015-01462

Sahoo, A. (2020). Clinical nutrition and therapeutic diets: new opportunities in farm animal practice. *EC Veterinary Science*, *5*(4), 12-29.