

mass, length, and villus height: crypt depth ratio in newborn kids, suggesting long-term consequences for nutrient absorption and growth potential (Figure 2) (Santos et al., 2023).

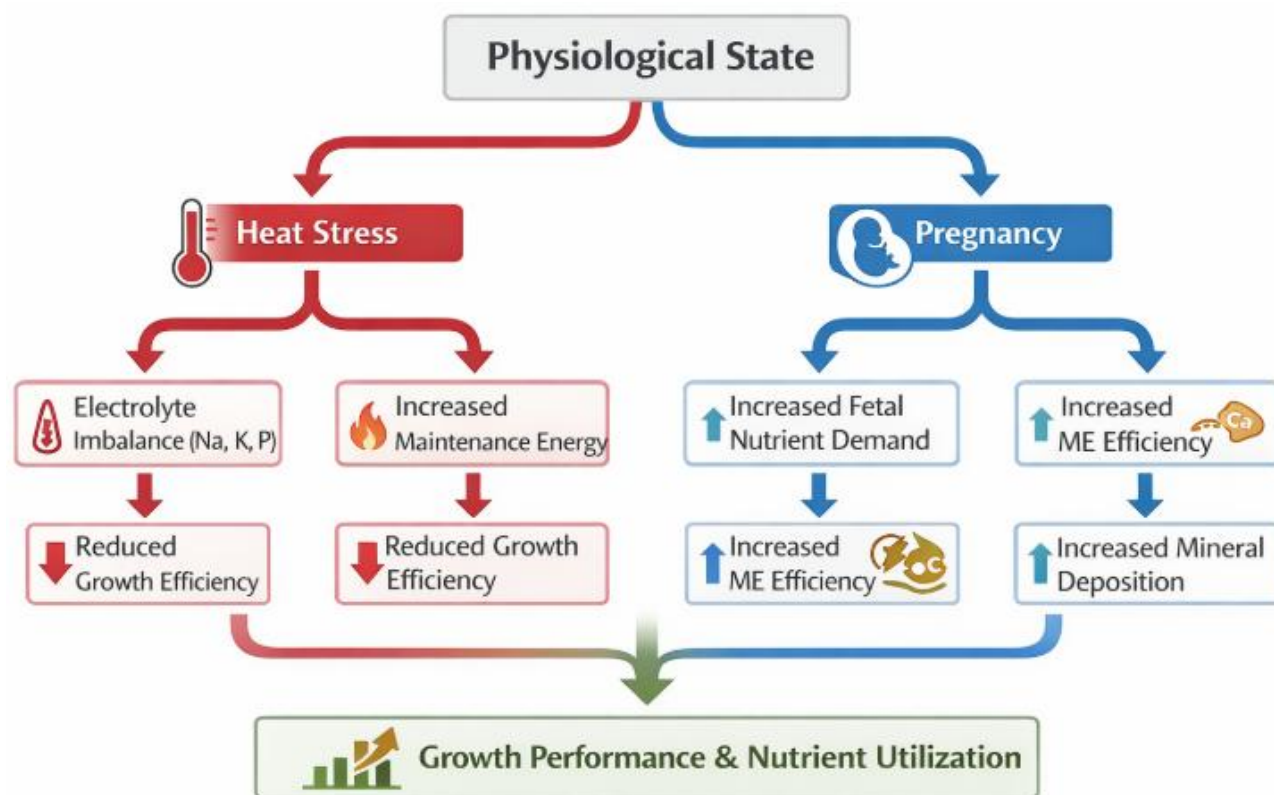


Figure 2 Effects of maternal undernutrition on gastrointestinal development in offspring goats. The diagram compares intestinal morphology under normal and restricted nutritional conditions, highlighting differences in intestinal size and villus structure (Adopted from Santos et al. 2023)

### 3.2 Scientific ratio of roughage and concentrate feed

Balancing roughage and concentrate is fundamental to maintaining rumen health while supplying adequate energy and protein for growth. Concentrate supplementation consistently improves dry matter intake, nutrient digestibility and growth when goats are otherwise dependent on low-quality forages or grazing alone. In Jamunapari does under semi-intensive conditions, increasing concentrate from 150 to 300 g/day alongside roughage significantly improved intake of digestible crude protein and total digestible nutrients, as well as digestibility of dry matter and crude protein (Shoshe et al., 2021). Similarly, in Barbari kids fed pulse-straw diets, raising concentrate mix to 2.1% of body weight enhanced weight gain, total VFA production and nitrogen retention, indicating more efficient nutrient utilization in finisher goats (Dutta et al., 2025).

However, excessively high concentrate and low forage can compromise rumen function, welfare, and long-term health. Rumen development in young kids benefits from higher roughage proportions: in early-weaned Balady kids, a 70:30 concentrate:roughage diet increased total volatile fatty acids, ammonia nitrogen and ciliate protozoa counts and was recommended as a high-roughage strategy for rumen development (Aziz et al., 2018). Forage-to-concentrate (F:C) ratio also affects behavior and stress; in goat kids, a 20:80 F:C diet produced superior growth but was associated with more stereotypic behaviors such as bar and bucket biting, while higher-forage diets elevated cortisol at extreme roughage levels, indicating the need to avoid both forage deficiency and excess under intensive systems (Tölü, 2025). Under comparable feeding regimes, altering concentrate:roughage ratios (3:7 vs. 5:5) changes fiber digestibility and rumen fermentation patterns, highlighting that optimal F:C ratios must be tailored to growth stage and production goals while maintaining rumen pH and microbial stability (Lin et al., 2023).