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Why Do Indian Rhinos Eat Elephant Grasses

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Abstract: Indian rhinos can live on less nutritious fibrous tall elephant grasses due to their massive body size and heavy weight along with extended surface area resulting lower rate of metabolism. It results in decreasing requirement of food per kilogram body weight. Their hypsodont type of dentition has also been adapted for chewing coarse grasses. These grasses provide them bulk diet but contain much, nearly indigestible, cellulose, hemi cellulose and lignin. Rhino is basically a hind gut fermenter with a much longer small intestine associated with a caecum where the tough fibrous indigestible parts of the elephant grasses are fermented. Increased retention time of food in long small intestine for a complicated fermentation process is the characteristic feature. The large intestine plays the role of absorbing fatty acid and remaining water. Overall, the rate of passing of food is slow. They require huge amount of food per day so they pay very little attention in selective foraging. The ratio of surface area to volume is low in rhino necessitating a smaller caloric intake.

Keywords: *Elephant Grasses, Hind Gut Fermenter, Fermentation, Small Intestine*

I. INTRODUCTION

Being a perissodactyle and hind gut fermenter (Sinclair *et.al*.,2006), Indian rhino has the capability of digesting less nutritious food items (Bell.1971; Jarman,1974), such as, tall elephant grasses which have much amount of cellulose, hemi cellulose and lignin content but less nutritious plant material. Since Indian rhino is a large herbivore, average weight is about 2000 kg, their basal metabolic rate is lower than smaller animals (Clutton-Brock and Harvey,1983). Greater the surface area lower the rate of metabolism, thatswhy, they can manageon roughage fodders. It has been estimated that the nutritional requirements often vary disproportionately with body size. It is again dependent on the seasonal food availability with a fluctuation of their general biology.

Dentition type:

Fig.1 The teeth of rhinoceros showing hypsodont type of dentition

During the course of evolution, Indian rhinos have gradually evolved from browsing to grazing habit. Hypsodont type of dentition (Fig.1) has been gradually developed for chewing coarse grasses. Premolars have been molarified with high crowns embedded in thick enamel content and a facial extension has been occurred. Such dentition type is the characteristic of grazers. The cheek teeth of Indian rhinos fall under the category of "sidewall hypsodonty", which are, actually, dominated by high side walls that are covered with enamel (Koeningswald,2011).

Selection of food plants:

Inspite of that, large herbivores like rhinos who are grazers in particular, in absence of nutritious, succulent food plants are forced to take taller plants. The taller plants provide a bulk diet, giving a support for their height and weight though those plants possess much cellulose and lignin. As for example, cellulose percentage is found highest in *Imperata cylindrica* (61.01 ± 4.61), followed by *Phragmites karka* (57.30 ± 4.61) and *Saccharum spontaneum* (57.24 ± 4.28) respectively which are very well known rhino fodders (Thakur *et.al.* 2014). On the other hand, in the low level plants, which are more nutritious and low in lignin and cellulose content, the rate of hourly intake is very low and does not provide much energy. So the large herbivores usually like feeding on the intermediate sized plants.

The process of digestion:

The large herbivores like rhinoceros evolved a much longer small intestine with a side pocket, known as cecum at the distal end of the small intestine just to ferment a fairly large amount of cellulose, hemi cellulose and lignin or other undigested food residues.The small intestineis associated with an increased retention time (Sinclair,*et.al*.,2006) which takes a complicated fermentation process in the hind gut. For doing this they have also been adapted using microorganisms such as bacteria, protozoa and fungi to digest non digestible matters by fermentation (Chivers, *et.al.*,1994). Food materials must be retained in a fermentation chamber long enough for the microorganism to cause fermentation before moving into the large intestine.The calculated mean retention times of fluids and particles in the whole gastrointestinal tract averaged 42 and 61 h, respectively, and were the longest ever recorded in a monogastric ungulate (Clauss,*et.al*.(2005). The small intestine plays a major role in breaking down of foods by enzymatic actions followed by absorption into the bloodstream.

The large intestine plays two main roles,1) absorb most of the remaining water into the body again to get rid of dehydration and 2) at the end of the fermentation in cecum the short-chain fatty acids produced are absorbed and utilized, thereby providing energy. Endo,*et.al*.(2000), in an anatomical case study of African white rhinoceros (who are also grazers), have shown that the cecum may be functionallyreplaced by the well developed colon which may act as themain fermentation tank in this animal. The same feature has also been observed by Stevens and Hume (1995).The absorption of microbial protein is little known.However, the hindgut fermenters like rhinos are to some extent less efficient than the ruminants who can digest high fibrous foods, but since only indigestible parts are

fermented in the cecum of rhinos they do not experience the loss of energy.

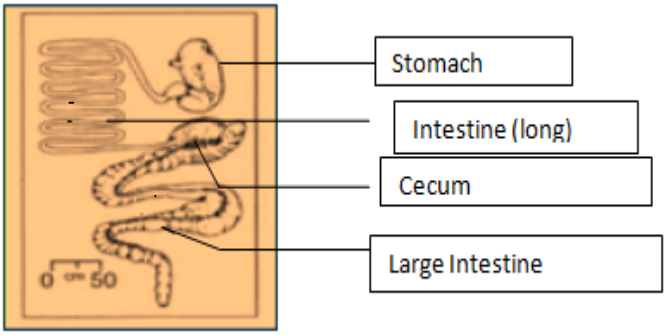


Fig.2: The alimentary canal of Indian rhinoceros(Redrawn after Edward and Hume (1998)

Indian rhino do not need to ingest high energy andprotein per unit of body weight. Since food material can be retainedin the gut for longer periods in them, the rate of passage may be slow enoughfor fermentation and absorption of fatty acids to take place.

The foraging time and selection of food:

Indian rhinos, being a large perissodactyle, need a huge quantity of food per day, as a result of which, they pay very little attention in selective foraging. They eat any kind of low quality elephant grasses which come on their way, as they require more nutrients in each day than the smaller mammals need, such as hog deer. Relative requirement in rhino is low, so they can adjust with the nutritional needs with relatively lower quality food. The dry mature elephant grasses in the dry season, i.e., in March, April, May and early part of June, possess proportionately high fibre and low nutrient. Despite dryness they do not hesitate on foraging those plants.

Food Intake Capacity in relation to Body Weight:

Food requirement directly varies with the increasing body weight due to increasing costs for maintenance of the body (Moen 1973). Fig.3(a) shows the direct relationship between food intake and body weight where Indian rhinos take as much as 19 kg per day although their percentage of intake according to body weight is fairly low in comparison to other medium sized herbivores (Fig.3b). However, the increase or decrease is not linear (Cordova *et.al.*1978). According to an estimation done by Kleiber (1961),it is found that the basal metabolicrate (kcal/day) of mammals is approximately seventy times thethree-fourth power of their body weight (in kg).So, it is quite evident thatthe Indian rhinos require more nutrients per day than smaller mammalsdo, their relativerequirements(per unit weight of body tissue)are lower. Gradual diminishing consumptions of food intake in gm/kg/day from medium to large sized herbivores have been graphically represented in Fig.3(c).

Bell (1969, 1971) has opined that where forage quantity is limiting but has higher nutritive value, smaller body size is advantageous; on the other hand, where forage quality is limiting large body size is fit to that environment. So, the habitat of tall elephant grasses has become a blessing on the unicorns.

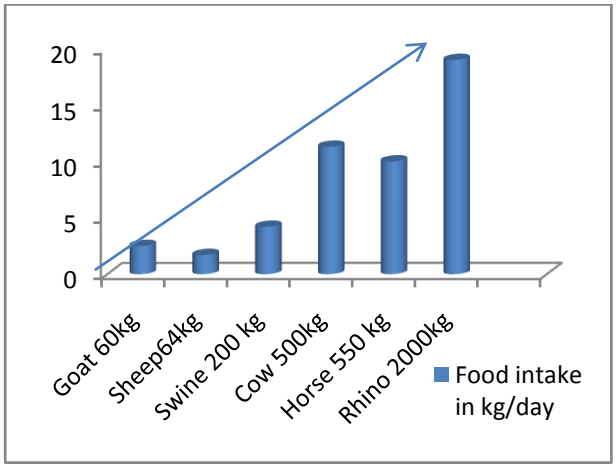


Fig.3(a): Food intake in kg/day according to body weight in medium and large herbivores (Warrington,2001, except rhinoceros)

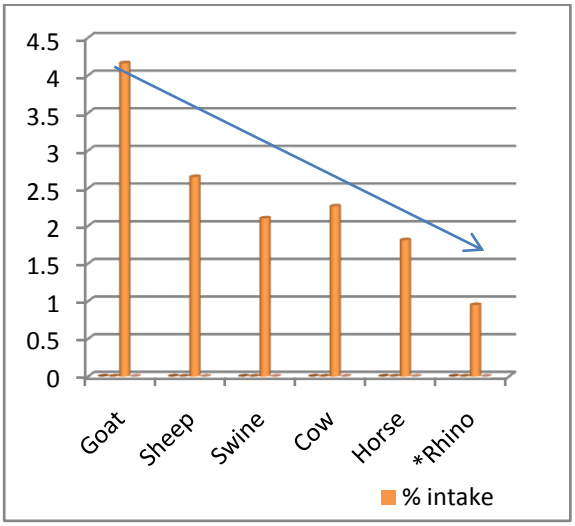
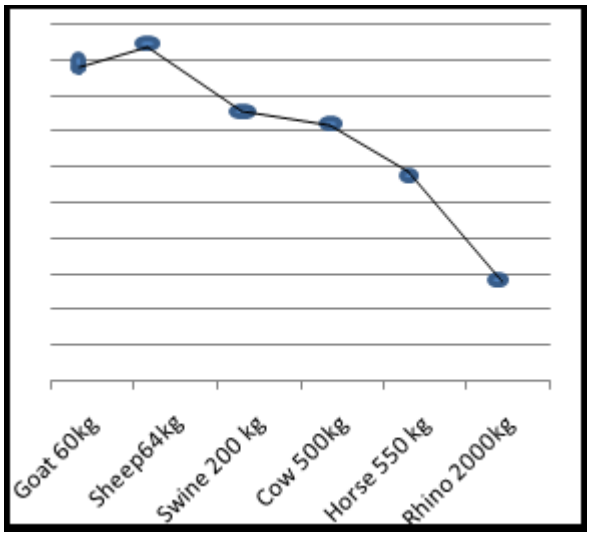


Fig.3 (b): Food intake % according to body weight in medium and large sized herbivores



30gm 35gm 24 gm 23 gm 19gm 9.5 gm respectively in goat,sheep,swine,cow,horse,rhino

Fig.3(c): Diminishing consumption of food intake in gm/kg/day from medium to large sized herbivores. (after Warrington,2001)

As Indian rhino is having an increased surface area because of its huge volume as well as heavy body weight the proportion of relatively inert or non-metabolizing tissue is

higher than smaller herbivores. It results in decreasing requirement of food on per kilogram body weight.(Warrington,2001). Heat loss is a function of surface area and temperature differential and the ratio of surface area to volume is much smaller in rhino necessitating smaller caloric intake just to maintain body temperature.

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