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Sloth bear's fecal tale: A gross observation and interpretation of captive sloth bear's feces to understand the health status

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Abstract
In the wild, Sloth bears possess a wide range of food habits for which fecal consistency and appearance couldn't be incorporated. However, in captivity, there is a standardized diet formulation concerning their nutritional needs and behavioural welfare. Non-invasive monitoring of fecal samples is paramount to understanding overall health status, including gastrointestinal (GI) disorders, and worm burden etc. Although several studies on scat analysis of sloth bears are available, the gross appearance of feces correlated with health status is largely unexplored. Here we attempted to establish a standardized fecal consistency grading system following the phenotypic appearance of feces cohere with GI health. Our observations revealed the highest prevalence of soft semi-solid feces "always" with no shape and firm and semi-dry feces "often". Comparisons were made with respect to the dietary factors, fecal consistency, health status, and incidence of any abnormality. The current study's findings build an empirical base to understand gastrointestinal health through gross observation of feces.

Keywords: Sloth bear, feces, appearance, consistency, composition, odour, GI health

1. Introduction
A large population of wild animals in captivity is reported to be reduced disease resistance ability and increased susceptibility to parasitic infestation (Dashe & Berhanu, 2020; Varadharajan & Subramanian, 2003) [4, 19]. The gastrointestinal (GI) tract is paramount in maintaining an animal's overall health condition. Gastrointestinal health of captive wildlife could be attributed to various factors such as variability and equilibrium of diet, intestinal permeability, gut microbiota, host immunity and interaction, effective digestion, and absorption (Pietro *et al*., 2018) [15]. In captivity, persistent non-invasive monitoring of feces condition, appearance, consistency, composition and odour facilitates understanding the gut health and digestive efficiency of animals (Nijboer *et al*., 2006; Pietro *et al*., 2018; Whitehouse-Tedd *et al*., 2015) [15, 12, 21]. Several studies have facilitated fecal consistency and comparative objective grading scale for felids and canids to address animal health and welfare (Cavett *et al*., 2021; Kerr *et al*., 2012; Whitehouse-Tedd *et al*., 2015) [3, 10, 21]. Contrastingly, applying the existing fecal consistency grading scale in domestic dogs and cats could be challenging to captive and free-living wildlife as of the differences in diet. In zoos, bears are considered to have few problems and are relatively free from diseases which may be attributed either to "an extraordinary resistance against all kind of diseases" or to "an unbelievable ability to conceal symptoms of sickness and pain" (Hage & Dorrestein, 1994; Rietschel, 1994) [7, 18]. Hence continually adopting the multifaceted diagnostic approach in terms of addressing veterinary challenges in *Melursus ursinus* could be highly beneficial. So, the voided feces are an important clue to understand the physiological status of an animal that encourages practicing health monitoring through non-invasive sampling, managing species of concern and claiming animal welfare (Dib *et al*., 2019; Pannoni *et al*., 2022) [6, 13]. Among ursids, in captive Brown bear (*Ursus arctos*), De Cuyper *et al*. (2021) [5] forms the basis of diet consumption and fecal consistency. To understand home ranges and habitat use by *Melursus ursinus*, there are several studies based on the food habit through scat analysis (Paul & Kumar, 2021; Ramesh *et al*., 2009) [14, 16].

However, physiology associated with Sloth bears gastrointestinal health through non-invasive monitoring of feces is largely unknown.

Here we aim at establishing a fecal consistency grade correlated with gastrointestinal health in Sloth bear (*Melursus ursinus*), with a highly varied omnivorous diet (Bargali *et al*., 2020) [1]. Despite the large conservation, management, and physiological interest, to our knowledge, apart from *U. arctos*, no such scaling concerning GI health is available for *M. ursinus*. This study has attempted to evaluate GI health and digestive processing through continuous monitoring and gross examination of feces non-invasively.

2. Materials and Methods

The observational study was conducted for two decades i.e., from 2003 to 2022 at Agra Bear Rescue Facility, where over 400 rescued and rehabilitated Sloth bears (age: 2-30 years; body mass: 45-140 kg) are under veterinary care and treatment with an enriched diet of porridge (native grains cooked with quantum sufficient water) and seasonally available fruits. However, in addition to this, bears ingested other vegetation that grew naturally within enclosure premises.

We conducted daily observations of feces at both indoor and outdoor enclosures during the morning and evening feeding. All feces were photo-documented, handled, and collected at the latest 0.16-24 h after defecation. The tactile and visual grading was done when classifying and labelling the feces. Later, to understand gastrointestinal health, veterinary observation i.e., physiology and health condition of the animal along with fecal pictures were interpreted to develop fecal conte of Sloth bears.

Although, we standardized our observations to establish fecal grading scale based on score, appearance, shape, dietary components, and tactility (Table 1). Thereafter, the fecal samples were subjected to parasitological and microbial examination by standard sedimentation, floatation, and culture techniques to understand the exact etiology.

3. Results and discussion

Among the experimental feces and consistency, well-formed feces scored 5 (feces of apparently healthy animal), followed by moist-turd-pile feces (Score 4). An increased proportion of viscous liquid in the feces seemingly led to a decrease in the score (Table 1). Overall, based on diet, a major portion of feces scored 3 (Score 3; Table 1).

Table 1: Standardized faecal consistency score of *M. ursinus*

Score consistency	1	2	3	4	5
Description	Entirely liquid	Moist to liquid	Moist and viscous faeces	Moist, well-formed, visible cracks	Well-formed, structure-rich material
Shape	Plaques	Viscous liquid with minor areas solid shape	Pile, circular perimeter	Turds, piles	Turds, pile or scattered
Tactile	Poor, no density	Liquid with some viscosity	Soft, squashable, difficult to pick up	Soft, falls apart while picking up	High density, rough, leaves no residue when picked
Possible dietary components	Milk	Vegetation	Fruit and grass	Fruit and vegetable	Fruit, vegetable, grains
Example					

Our observations suggest that *M. ursinus* diagnosed with verminous enteritis, leads to the passing of mucoid blood-tinged feces followed by intestinal inflammation or ulceration (Figure 1). Symptoms of enteritis may include nausea, vomiting, inappetence, and abdominal pain. However, gastrointestinal parasites are common in sloth bears. Routine monitoring and administering anthelmintic periodically with proper sanitary measures would reduce the parasitic infection (Manjunatha *et al*., 2018) [11]. Some of the feces were grey or brownish-black, whereas the consistency varied from mucoid to watery, revealed the animal was suffering from hepatitis and cholangiocarcinoma (Figure 2). In this condition, visual evaluations suggest those animals exhibit symptoms of the bulged abdomen, ascites, generalized jaundice, inappetence, intermittent vomiting, facial and peripheral oedema based on the severity of the condition (Ilayaraja & Sha, 2021) [8]. Etiological factors such as seasonal changes in diets, coarse and fibrous particles in feed, and excessive dietary carbohydrates expedite the frequent passage of watery feces i.e., diarrhoea (Figure 3). Although, a diarrhoeic condition in an animal could also be associated with physical, chemical, and biological factors (Bhikane & Kawitkar, 2022) [2]. Exceptions would occur during excess milk consumption when the animal passes yellowish diarrhoeic feces. The circumstances of food intolerance and allergies require dietary changes and probiotics. To date, healthy *M. ursinus* has been reported for voiding partially digested (*Cucurbita* spp., *Daucus carota*, *Cocos nucifera* and *Citrullus lanatus*) or

undigested feed particles (seeds of *Phoenix dactylifera*, *Lantana camara* and *Ziziphus mauritiana*) through defecation (Figure 4). Cases of rectal impaction in *M. ursinus* followed by inappetence, anorexia and constipation revealed excessive consumption of Bengal gram, coconut pieces, and groundnuts with shells (Ilayaraja *et al*., 2012) [9]. To enhance digestive permeability and nutrient absorption the boiled vegetables and fruits should be smashed/slurred properly before offering the animal.

In some cases, we found animal passing greenish mucoid feces due to bacterial enteritis where oral or parenteral antibiotics needs to be given (Figure 6). Including indigestible components, such as hair, followed by trichotillomania or trichophagia, leads to trichobezoar (Figure 7). An incident of intestinal trichobezoar lead to death of Sloth bear reported the bear was exhibiting symptoms of listless, dull and depressed with poor appetite (Rao & Acharjyo, 1979) [17]. Although, instances of compulsive eating disorder in *M. ursinus* associated with eating soil where they pass muddy colored feces (Figure 5).

Ideally, healthy feces shouldn't have any sort of mucus, blood, and undigested food particles. However, the occasional instance of mucus is normal as it's what allows feces to slide through the rudimentary colon. In addition, the presence of few body hairs in feces is normal because of the physiological process associated with peculiar licking and phonation habit that includes paw sucking in Sloth bears (Rao & Acharjyo, 1979; Weissengruber *et al*., 2001) [17, 20].

Fig 1: Gross appearance of faeces for *M. ursinus* diagnosed with verminous enteritis

Fig 2: Gross appearance of faeces for *M. ursinus* diagnosed with Hepatic disorder

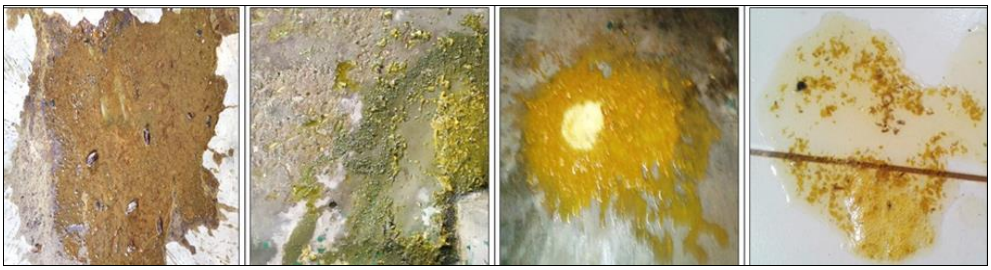

Fig 3: Gross appearance of faeces for *M. ursinus* diagnosed with Diarrhoea

Fig 4: Gross appearance of faeces for apparently heathy *M. ursinus* with partially digested and fruit material

Fig 5: Gross appearance of faeces for *M. ursinus* exhibiting compulsive eating disorder (Pica)

Fig 5: Gross appearance of faeces for *M. ursinus* diagnosed with bacteria gastroenteritis

Fig 5: Gross appearance of faeces for *M. ursinus* diagnosed with trichobezoar

4. Conclusion

This contribution offers a fecal tale correlated with gastrointestinal health for Sloth bear (*M. ursinus*) and can be used in captive settings as a part of monitoring and health assessment. However, apart from this, the fecal consistency and gross appearance may vary according to the animal's diet, age and gender, and environmental conditions. Further studies should be conducted to understand the causes and consequences of dual consistency feces. Yet, based on our observations, we postulate a gross appearance of feces associated with gastrointestinal health. In addition, this observational study would sensitize and make aware animal care staff and biologists to interpret and gather potential clues for veterinarians in addressing health care.

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