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Pollen Count as an Indicator to the Animal Diet Botanical Composition at a Selected Wet Season Grazing Site Eastern Nile Khartoum State (Sudan)

Abdelrahim Elbalola[a*], Ibrahim Saeed[b]

[a]*Assistant professor, Biology Department Faculty of Science Tabuk University, Tabuk 71491, KSA*

[b]*Part time Lecturer, Faculty of Science and Technology Omdurman Islamic University, Khartoum 321, Sudan*

[a]*Email: aalbalolh@ut.edu.sa*

[b]*Email: ibsaeed77@gmail.com*

Abstract

This work aimed to identify the main plant species that compose the animal diet at the study site by counting their pollen in animal feces. The site selected for this study was Wadi El Farish, Eastern Nile (Khartoum State). Fresh sheep, goats' and camels' feces samples were collected from the site at the mid rainy season, chemically treated with 10% KOH and acetolysed according to the Standard Acetolysis Method for Recent Pollen Grains [1]. Pollen grains were counted in a total of 10 slides of one drop sample each, mounted in glycerin, using the light microscope. Each pollen type was counted separately in transects throughout the sample. The Complete Randomized Design was employed to test the effect of plant species on number of pollen per drop sample and the mean numbers of pollen in animal feces were separated using the Duncan's Multiple Range Test. Results showed that grasses had the highest ($P<0.05$) mean numbers of pollen in goats' and camels' feces while, *Indigofera* had the highest ($P<0.05$) one in sheep feces. *Acacia* pollen showed the lowest ($P<0.05$) mean numbers of pollen in both goats' and camels' feces while, *Tribulus* had the lowest ($P<0.05$) one in sheep feces. It can be concluded that goats' and camels' diet is mainly made up of grasses, some forbs and a small amount of browse; sheep diet is made up of forbs, grasses and a small amount of browse. Contribution of grasses, forbs and browse to animal diet revealed by this study differs from that found by other workers.

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* Corresponding author.

This may indicate that animal diet botanical composition is influenced by the plant species composition of the particular site. Plant species not represented in feces by their pollen might be of varying contributions to animal diet. Hence, pollen count is better used as an indicator to key species or species much utilized by the animals rather than a basis for determining the animal diet botanical composition. Presence of pollen in feces means that the plant has been eaten during the flowering time and before fruiting and seed dispersion. This, in turn, means that such species are endangered. Small amount of browse species pollen in animal feces indicates that browsers (camels and goats) are selective i.e. eat only leafy twigs of trees and shrubs.

Keywords: pollen; grazing; animals; botanical; composition.

1. Introduction

In dry savannah and semi-desert regions, natural rangelands guarantee the feed requirements of livestock for a particular period depending on the amount and duration of rainfall during the rainy season. Even though, browse and shrubs are effective insurance against seasonal feed shortages; they constitute vital components in livestock productivity in arid and semi-arid zones as they balance protein deficiency during the long dry summer season. Both parameters: animal diet botanical composition and pasture species composition could be very useful in designing range management practices, such as selecting species required for reseeding of deteriorated range and in identifying key species that will form a base for range management [2]. The diet of various animal species are expected to be different [2,3]. The Bite-Count Method of van Dayne [5] is commonly used in the determination of animal diet botanical composition. The results revealed by the authors in [2] indicated that cattle and sheep diet was composed mainly of grasses, some forbs and a small amount of browse. Goats diet witnessed an increase in the percentage of browse at the expense of grasses and forbs. Close results were found by the authors in [6]. Earlier investigations of the diet and grazing habits relied on analyses of macro remains in stomach or feces and on counting feces [7,8,9,10]. KOH/acetolysis method [11,12] is commonly used for extraction of pollen. Authors in [13] followed a modified version of the standard KOH/acetolysis method. Pollen is easily recognized after digestion; methods for preparation and identification of pollen are well known and developed. In addition, feces are easy to collect and are sampled without killing, and only minimal disturbing the animals [14].

2. Materials and Methods

2.1 The study area

The study area falls within the semi-arid part of Sudan which covers an area of 492,098 Km^2 that represents 19.7% of the total area of the country. Rainfall ranges from 75 to 300mm which extends from July to September [15]. Administratively, the study area belongs to Khartoum state bordered by Gedarif state from the east, River Nile state from the North, Gezira state and White Nile state from the south and Northern Kordofan state from the West. Khartoum state is divided by the River Nile (Blue, White and the main river) into two parts namely Eastern Nile and Western Omdurman. According to the comprehensive Agricultural census of 2009, area of Khartoum state occupied by natural rangelands and forests was estimated by 2.1 M ha. More than 1384000

heads of livestock are found in the state, of which, 24000 are cattle (17%), 7000 camels (1%), 513000 sheep (37%) and 624000 goats (45%). The site selected lies Eastern Nile, that is Wadi El Farish; coordinates: 15° 42.289′ N, 033° 06.283′E. It is about 70Km from the Blue Nile, direction of flow is North-South. Soil profile shows a reddish fine upper sandy layer of few centimeters depth followed by a heavy muddy clay layer of few meters. The soil is alkaline with sandy clay textural class. The tributaries of Wadi El Farish are Wadi El Tibsa in the Northeast, Wadi El Arbash in the Northwest and El Kitair in the Southeast. Watering points include Hafeer Wad El Hoori in the Southwest, Hafeer Wad El Nour in the Southeast in Addition to Wad Ata El Mannan. Vegetation cover is composed of woody perennials (mainly Acacias) dominated by *Acacia tortilis* subsp. *spirocarpa* (samur) followed by *A. ehrenbergiana* (salam), *A. tortilis* subsp. *radiana* (seyal), and few *Ziziphus spina-christi* (sidir). Perennial grasses are represented in this site by only one species that is *Panicum turgidum* (tumam). Annual forbs which complete their life cycles during the rainy season up to the beginning of winter include *Indigofera hochstetteri* (shara), *Boerhavia repens* (tarba), *Euphorbia aegyptiaca* (um malbein), *Tribulus terrestris* (dereisa), *Corchorus oletoreus* (khudra), *Amaranthus gracizans* (lisan tair sagier) and *Morettia sp.* (Ghubeish). Annual grasses include *Aristida mutabilis* (gaw) and *Dacelochtenium aegyptium* (umasabie).

2.2 Sampling and analysis of animal feces

Considerable amounts of recent camels, sheep and goats' feces were collected from the study site during the rainy season and kept in labeled paper bags. Feces samples were then taken to the laboratory for pollen analysis. Animal diet botanical composition was determined using quantitative and qualitative analysis of pollen present in the animal feces as an indicator to the plant species consumed by the animals. This was based on the fact that pollen of each species or group of species from the same taxonomical group is characteristic. In addition, pollen is easy to recognize, identify and count. Fresh animal feces were washed with water to remove any probable pollen deposited on the outer surface of feces. Animal feces was chemically treated with 10% KOH and acetolysed according to the standard acetolysis method for recent pollen grains [1]. Pollen samples were finally stained with basic fuchsin pigment and stored in stick vials. Pollen grains were counted in a total of 10 slides prepared by taking one drop sample on the slide, mounted in glycerin, covered with a cover slip and adjusted under the light microscope. Each pollen type/species was counted separately in transects by moving the slide from left to right/right to left. This continued until the whole sample was covered and the number of pollen per sample was recorded. Photographs of different pollen species were taken by a 14 mega pixel (Sony-CYPER SHOT) digital camera (Plates: 1-4). Pollen was identified by entering the genera names of the species present in the study site to the Australian Pollen and Spore Atlas (APSA) web site (apsa.anu.edu.au) [16] Which is designed to enable free online accessibility to the largest collection of pollen and spore information. The atlas gives an image of the particular genus pollen grain; by comparing this image to the photos of pollen detected in animal feces the pollen was identified.

2.3 Statistical analysis

Complete Randomized Design was employed to test the significance of effect of plant species on the number of pollen in animal feces according to [17]. Mean numbers of pollen of different plant species from feces of each animal species were separated using the Duncans Multiple Range Test [18].

3. Result and discusion

Table 1: Mean numbers of pollen of different types in animal feces

Pollen type	Animal species		
	Sheep	**Goats**	**Camels**
Grass	16.40[a]	27.70[a]	175.60[a]
Tribulus	0.10[c]	2.00[b]	5.20[b]
Indigofera	22.20[a]	0.00	0.00
Acacia	0.60[b]	0.20[b]	0.10[b]
SE±	2.04	2.94	8.52

Means having similar superscripts within the same column are not significantly different at (P<0.05) according to DMRT.

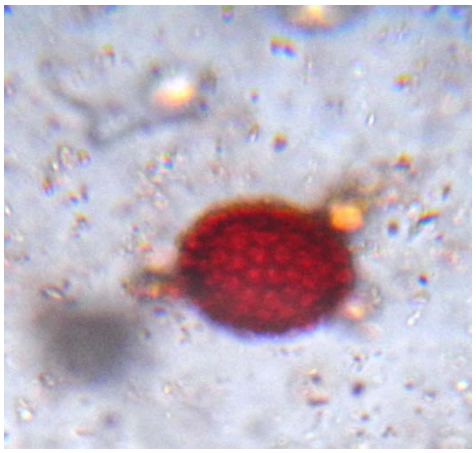

Plate 1: *Tribulus* pollen

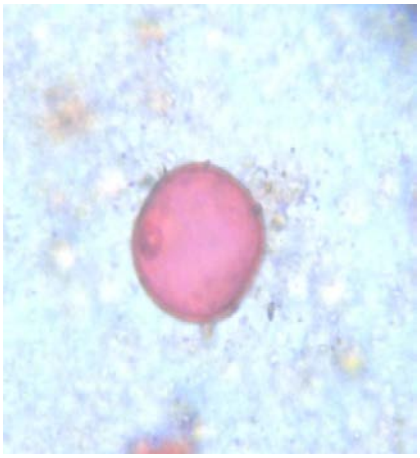

Plate 2: *Grass* pollen

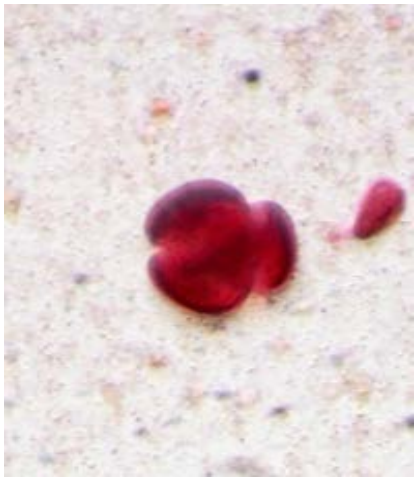

Plate 3: *Indigofera* pollen

Plate 4: *Acacia* pollen

Mean numbers of pollen of different types in feces of different animal species are shown in table (1). Grass pollen showed the highest ($P<0.05$) values in feces of goats and camels (27.70 and 175.60 respectively) while, *Indigofera* pollen showed the highest ($P<0.05$) value (22.20) in sheep feces. *Tribulus* pollen showed the lowest ($P<0.05$) value in sheep feces while, *Acacia* pollen showed the lowest ($P<0.05$) value in both goats' and camels' feces. In sheep feces, *Acacia* pollen (0.60) was found to be more than *Tribulus* pollen (0.10), but less than that of *Indigofera* pollen (22.20). *Tribulus* pollen was more than *Acacia* pollen in both goats' and camels' feces, and *Indigofera* pollen was not detected in feces of the two latter animal species. This result shows that the diet of goats and camels was composed mainly of grasses followed by forbs and browse. Sheep were found to prefer *Indigofera* which is a forb species over grasses and browse; but also prefer *Acacia* which is a browse over *Tribulus* which is a forb species. This result disagrees with that found by the authors in [2] who stated that goats prefer to browse in all seasons; sheep select more grasses in the wet season. Selection of *Indigofera* which is known to be rich in protein before grasses by sheep found in this work agrees with that forage high in crude protein is highly palatable to cattle and sheep [19,20,21,22]. This also indicates that the order of preference (grasses followed by forbs and then browse) stated by the authors in [2] and [6] is not valid in all sites and

preferring grasses over forbs or *vice versa* depends on the plant species composition of the particular site, meaning that even within grasses or forbs, some species are preferred over the others, some grasses are preferred over some forbs and *vice versa*, some browse are preferred over some forbs and *vice versa*. This confirms what was mentioned by the author in [23] that livestock accepted the grass cultivars highest in phosphorus and potassium before those with low contents of these minerals. This also comes in line with what mentioned by the authors in [24] who stated that browser (camels and goats) and to lesser extent intermediate feeders (sheep) are able to select quality feed. It is not necessarily that forbs recorded in the study site and whose pollen was not detected in the animal feces, are not utilized by the animals; they might be eaten before flowering or their inflorescence might be unpalatable to animals. These contrasting results may be referred to variation in the methods used to determine the Animal Diet Botanical Composition.

4. Conclusion

Grasses made the greatest contribution to goats and camels diet while, sheep preferred Indigofera over grasses; and Acacia over Tribulus. A mixture of grass, forbs and browse with a constant ratio might not be valid at all sites and animal diet botanical composition might be a matter of the plant species composition of each site. Using this method of pollen counting alone for determination of the animal diet botanical composition may be risky and can adversely affect the range management decisions especially selection of plant species for reseeding. This is because pollen of some plant species might not be detected in the feces (their flowers may be unpalatable or they may be consumed before or after flowering) and they, in fact, make great contribution to animal diet. Hence, pollen count is better used as an indicator for determining the preference of plant species by different animal species or in combination with other methods such as the Bite Count Method. Presence of considerable numbers of pollen of some plant species means that these species were eaten during the flowering time and before fruit setting and seed dispersion. Continuous consumption of such plant species with their inflorescence will eventually lead to deterioration of their numbers in the site and makes them endangered because their regeneration is not guaranteed.

References

[1]. K.. Faegri and J. Iverson Textbook of Pollen Analysis. 3rd. revised by K. Faegri. Copenhagen: Munksgaard, 1975.

[2]. A.O. Abusuwar, and E.O. Ahmed. "Seasonal variability in nutritive value of ruminant diet under open grazing system in the semi-arid rangeland of Sudan (South Darfur State)". Agriculture and Biology Journal of North America, vol. 3, pp. 243-249. (2010).

[3]. R.R. Hoffman. "The Ruminant Stomach Sructure and Feeding Habits of East Africa Game Ruminants". In East Africa Literature Bureaw. Nairobi, Kenya. 1973

[4]. R.N.B. Kay W.V. Engelhardt and R.G. White The digestive physiology of wild ruminants. In Digestive Physiology and Metabolism, Rucke buche, Y. and Thivend, P. Eds. Lancaster, NTP Press, 1980, pp.743-761.

[5]. G.M. Van Dyne Measuring quantity and quality of the diet of large herbivores. In Practical guide to study of the productivity of large herbivores Galley, F.B. and Bukgner, H.K. Eds. Oxford, England,

Blackwell Scientific Publication, , 1968.

[6]. D. L. Coppock, J. E. Ellis, D. M. Swift. "Livestock Feeding Ecology and Resource Utilization in a Nomadic Pastoral Ecosystem" The Journal of Applied Ecology, Vol. 23, No. 2. pp. 573-583. Aug., 1986.

[7]. T. Punsvik, , A. Syvertsen and H. Staaland. Reindeer grazing in Aventdalen, Svalbard. Proceedings of the 2nd International Reindeer/Caribou Symposium. Roros, Norway, 1979, pp. 115-123

[8]. H. Staaland, and T. Punsvik. Reindeer grazing on Nordaustlandet, Svalbar. Proceedings of the 2nd International Reindeer/Caribou Symposium, 1979. pp.142-150.

[9]. A. Staaland. On the quality of Svalbard reindeer pasture in the summer and autumn. Rangifer. Vol. 4 (1), pp. , 16-23, 1984.

[10]. A. Staaland. The nutrition of Svalbard reindeer. Svalbard reindeer and their basis for existence. Oritsland, N.A. (ed.), Olso. Universitets forlaget, 1986, pp. 72-91.

[11]. K. Faegri and J. Iverson. Text book of pollen analysis. Kopenhagen, 1964.

[12]. G. Erdtman. Handbook of Palynology. An introduction to the study of pollen grains and spores. Munksgaard, Copenhagen. 1969.

[13]. G. Bradd Witt, J. Luly and J.Fairfax . How the west was once: vegetation change in south-west Queensland from 1930 to 1995. Journal of Biogeography, 33, pp.1585–1596, 2006.

[14]. A. E. Bjune. Pollen analysis of feces as a method of demonstrating seasonal variation in the diet of Svalbard reindeer. Rangifer tarandus platyrhynchus. Polar Research. Vol. 19(2), pp. 183-192, 2000.

[15]. B.B. Zahran. The change in nutritive requirements due to change in livestock population in South Darfur, Sudan. Preliminary M.Sc. Thesis in Natural Resources Management. University of Western Australia. 1982.

[16]. Australian Pollen and Spore Atlas (APSA). apsa.anu.edu.au.

[17]. K. A. Gomez and A.A. Gomez. Statistical procedures for agricultural research, New York, John Wiley and Sons, 1984 , 680 pp.

[18]. D. B. Duncan. Multiple range and multiple F-test. Biometrics, vol. 11, pp.1-42, 1955.

[19]. W. A Hardison, J.T Reid, C.M. Martin, and P.G. Woolfolk. Degree of herbage selection by grazing cattle. J. Dairy Sci. vol. 37, 89-10, 1954.

[20]. C.W. Cook. (1959). The effect of site on palatability and nutritive content of seeded wheat grasses. J. Range Mgmt. vol. 12, pp.289-292, 1959.

[21]. R.E Blaser, R.E Hames, H.T. Jr., Bryant, W. A. Hardison, J.P. Fontenot, J.P. and R. W. Engel. The effect of selective grazing on animal output. In: Proceedings of the 8th International Grassland Congress, 1960, pp. 601-606.

[22]. G. W. Arnold. Some principles in the investigation of selective grazing. Proc. Aust. Soc. Anim. Prod., vol. 5, pp.258-271, 1960a.

[23]. J. H. Leigh. The relative palatability of various varieties of weeping lovegrass Eragrostis curvula (Schrad.) Nees. J. Br. Grassland Soc. vol. 16, pp.135-140, 1961.

[24]. T. Rutagwenda, M. Lechner-Doll, H.W. Schwartz, W. Schultka and W. von Engelhart. Dietary preference and degradability of forage on a semi-arid thorn-bush Savannah by indigenous ruminants, camels and donkeys. Anim. Feed Sci. Tech.vol. 31, 179- 192, 1990.