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Study of forage species of the maritime region of Togo used in livestock feed

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Abstract

Natural pastures constitute the bulk of livestock feed in Togo, but very few studies have been conducted on their nutritional value. The objective of the study is to identify in the maritime region located in the south of Togo plant resources available and recoverable in livestock feed. During the ethnobotanical survey in the field, the feeding behavior of grazing cattle was observed and made it possible to collect samples of grazed plants. A part of each sample is brought to the laboratory for taxonomic identification and then another part goes for bromatological analysis. The results obtained from the bromatological analysis of 40 most palatable plant species in the region showed that the moisture content of the samples varies from 2.23 to 9.43%. The rates of ash, fat and crude fiber vary respectively from 2.23 to 9.43%, from 1.29 to 30.33%, from 0.85 to 8.11% and from 6.03 to 32 .3%.

Keywords: Raising of ruminants; Natural pastures; Plant species; Feed value; Livestock feed

1. Introduction

The breeding of ruminants in Togo remains dependent on natural plant resources to meet their food needs, as in the majority of countries in Sub-Saharan Africa. In fact, cultivating grass to feed livestock has not yet entered the mores of stockbreeders in Africa south of the Sahara [1]. Natural pastures constitute the bulk of livestock feed, although these plant resources are unevenly distributed in space and time due to high seasonal and interannual climatic variability. To ensure the food of their animals, breeders adopt several strategies including transhumance, nomadism, etc. This requires great spatial mobility of animals for the exploitation of fodder resources. Indeed, animals roam, enter crop areas and destroy agricultural production, which creates permanent conflicts between breeders and farmers. On the other hand, overgrazing accentuates vulnerability and soil degradation [2, 3, 4] and leads to the loss of biodiversity and the extinction of species mutilated by the passage of animals in the dry season [5].

Several factors such as the floristic composition the typology of the fodder the regeneration remain biophysical indicators requiring additional investigations in order to better inform the structural evolution of grazed natural formations. The main woody fodder species that were harvested until the 1980s in the immediate vicinity of Lome can only be found today beyond a radius of 20 to 30 km from the city of Lome [6].

In Togo, direct grazing is the most frequent, oldest and most economical mode of exploitation [7]. However, it has some drawbacks such as waste overgrazing degradation trampling soiling by animal droppings [1]. The practice of intensive grazing on limited areas has led elsewhere to a significant reduction in plant diversity and the loss of heritage species [8]. With the gradual reduction of grazing areas linked to a multitude of factors including overgrazing, climatic hazards

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coupled with various anthropogenic activities, ruminant farming is increasingly turning to fodder production in order to provide animals with a suitable and continuous diet [9].

In a context of sustainable management of natural ecosystems, it becomes necessary to have a decision-making support tool for the sustainability of pastures. Unfortunately, very few studies have been carried out in Togo for a better understanding of the quality of the diversity and fodder value of natural stands. It seems appropriate to determine the bromatological fodder value of the plant species available in the country in order to help broaden the range of fodder plants easily accessible to breeders. The objective of this study is to identify within the plant resources available in southern Togo, which constitutes the Maritime region, the species that can be used in livestock feed.

2. Material and methods

2.1. Material

2.1.1. Study framework

The Maritime region is located in the South of Togo at the edge of the Atlantic Ocean. It extends between 6°00' and 6°50' North latitude and 0°25' and 2°00' East longitude and has Tsévié as its capital. With an area of 6395 km2 or 11.30% of the national territory, it concentrates 42% of the national population (2,599,955 inhabitants). It is limited to the north by the plateau region, to the south by the Atlantic Ocean, to the west by Ghana and to the east by Benin and enjoys a tropical Guinean climate with an average temperature of 27° vs. The amount of precipitation varies between 800 and 1100 mm per year [10]. It is characterized by two rainy seasons and two dry seasons. The big rainy season goes from mid-March to mid-July and the small rainy season extends from September to mid-November. The major dry season is from mid-November to mid-March and the minor dry season is from mid-July to the end of August [11. The soil of the site is a ferralitic soil formed from the continental deposit that covers part of the arable land of Ghana, Togo, Benin and Nigeria [12]. It is in this region of southern Togo that an ethnobotanical survey was carried out in the cattle market in Adeticope and on the sites of cattle breeders in Badja Kpome and Avepozo. During the ethnobotanical prospecting in the field, the plant species grazed by animals were sampled, i.e. 27 species harvested at Kpome 7 in Badja 6 in Avépozo and 4 species are sampled at the Adéticopé livestock market.

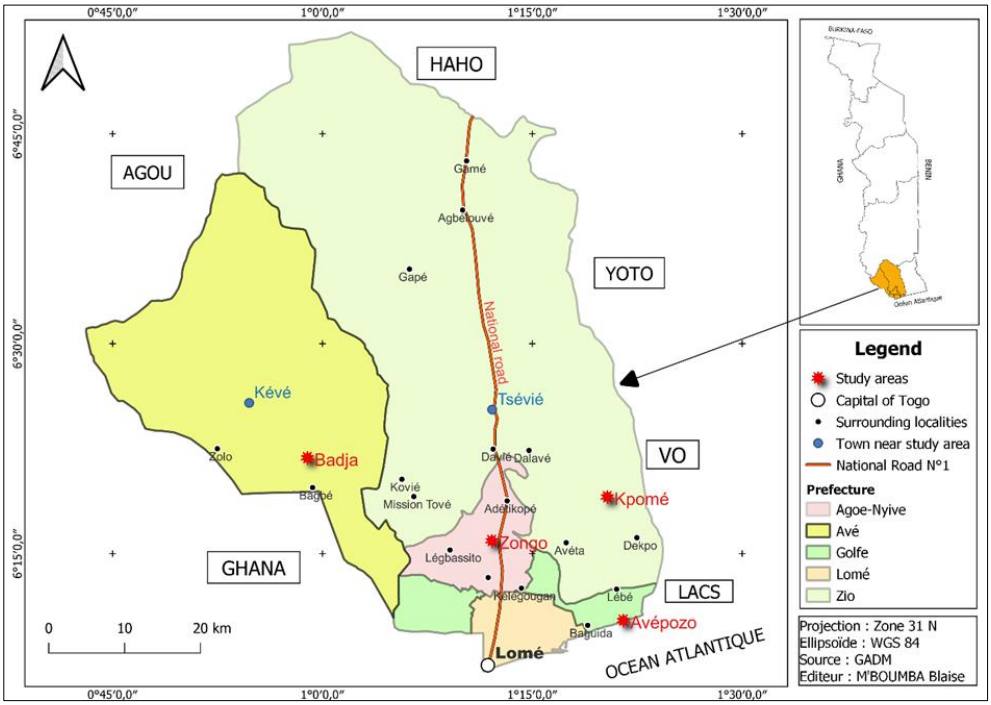

Figure 1 Map of Togo showing the location of the study area

2.1.2. Biological material

The biological material consists of plant species grazed by animals and sampled in the Maritime region of Togo. Here is a sample of the grazed plant species

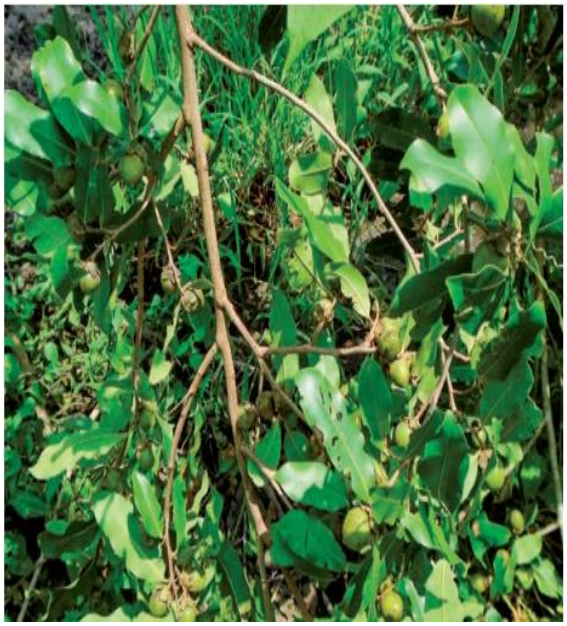

Figure 2 *Diospyros mespiliformis*

Figure 3 *Andropogon gayanus*

Figure 4 *Malacantha alnifolia*

Figure 5 *Ampelocissus bombycina*

Figure 6 *Panicum maximum*

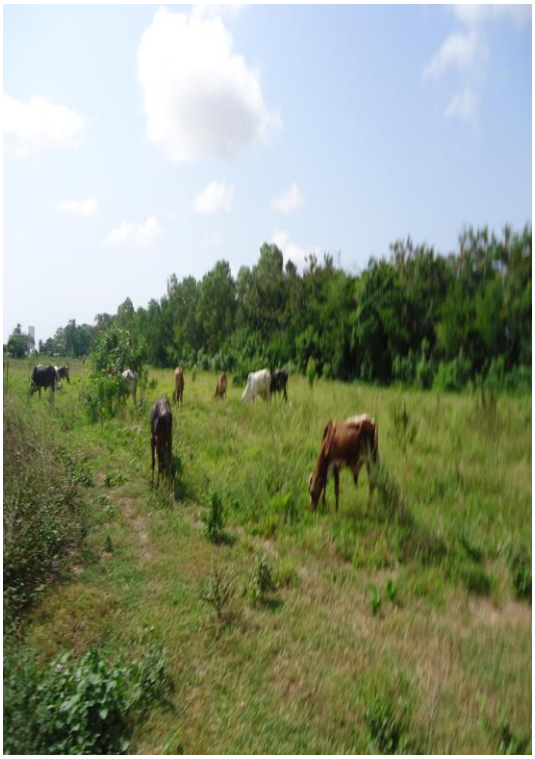

Figure 7 Monitoring the herd of oxen on pasture

2.2. Method

When monitoring grazing animals animal appetite was a determining factor in the identification and sampling of forage species. After the collection of samples of plant species grazed by livestock on the rangelands, part of each plant sample is sent to the botany laboratory of the Faculty of Sciences of the University of Lomé for taxonomic identification. Another part of these samples is brought to the Research Laboratory on Agroresources and Environmental Health (LARASE) of the Higher School of Agronomy of the University of Lome. The samples thus distributed are dried in an air-conditioned room with a temperature maintained at 25°C. Once dried, they are crushed (Figure 7) and stored in plastic bags for bromatological analyzes using two conventional methods, which are chemical analyzes and Near Infra-Red Spectrometry (NIRS). These chemical analyzes concerned the moisture content of fat, fiber and energy ashes. The energy levels of the samples were determined thanks to the table of Dijkstra [13].

Figure 8 Example of samples of dried plants

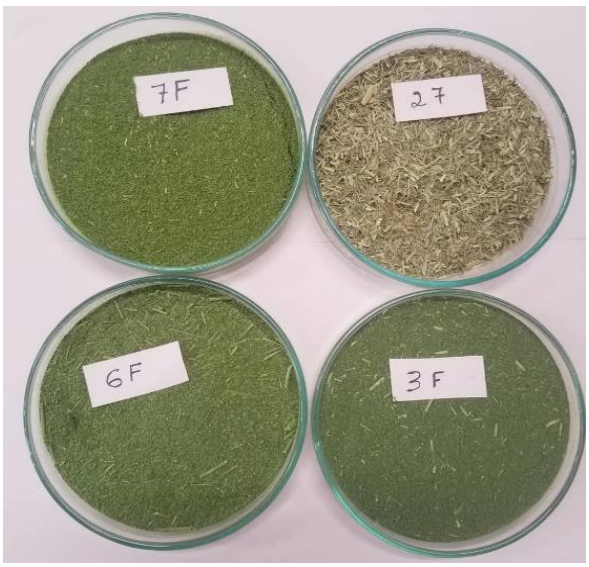

Figure 9 Example of crushed plants analysed

3. Results and discussion

3.1. Activities observed on the pastures

The essential activities observed on pastures during the monitoring of cattle feeding behavior are walking herbaceous pasture woody pasture watering rest and rumination. Walking is an important activity for animals in the search for food resources and water points. Herbaceous grazing is much more intense because cattle spend more time on herbaceous grazing than on woody grazing. During monitoring, watering generally takes place once a day between 1 and 2 p.m. The watering time hardly exceeds 15 minutes. Monitoring the feeding behavior of oxen on pasture shows that the pace of activity depends on many factors such as the animal's food preferences, the available fodder resources and the physical constraints of the environment. Oxen are most often grazed in groups and social relationships can affect individual feeding behavior. Our observations made on animal pastures are similar to those reported by Yanra [14] and Mopoundza and *al*. [15].

3.2. Fodder resources identified

The floristic inventory carried out during the ethnobotanical survey identified 40 plant species grazed by animals. These forages belong to 15 different families including *Poaceae Fabaceae Euphorbiaceae Sapindaceae Moringaceae Moraceae Musaceae Anacardiaceae Ehretiaceae Bombacaceae Rutaceae Rosideae Araceae Asteraceae and Chenopodiaceae*. Table 1 presents the fodder species identified and their respective families. The results obtained from the inventory of pastoral resources are recorded in Table 1. These results are similar to those of Dourma and *al*. [5] and Amégnaglo and *al*. [16] who studied the diversity, typology and quality of fodder in natural pastures in the Guinean zone of Togo.

Table 1 Forage species identified and their families

Scientific name	Family	Locality of development
Mucuna pruriens	Fabaceae	Kpome
Desmodium tortuosum	Fabaceae	Kpome
Gliricidia sepium	Fabaceae	Kpome
Pannicum maximum	Poaceae	Kpome/Adéticop
Paullinia pinnata	Sapindaceae	Kpome
Moringa oleifera	Moringaceae	Kpome
Antiaris Africana	Moraceae	Kpome
Pithecellobium dulce	Fabaceae	Kpome
Musa spp	Musaceae	Kpome
Manguifera indica	Anacardiaceae	Kpome
Cordia Africana	Ehretiaceae	Kpome
Adansonia digitata	Bombacaceae	Kpome
Albizzia spp	Fabaceae	Kpome
Acacia melifera	Fabaceae	Kpome
Leuceana leucocephala	Fabaceae	Kpome/Adéticope
Spondias monbin	Anacardiaceae	Kpome
Manihot esculenta	Euphorbiaceae	Kpome/Adéticope
Stylochaeton lancifolius	*Araceae*	Kpome
Bridelia ferrugineae	Euphorbiaceae	Kpome
Imperata cylindrical	Poaceae	Kpome
Griffonia simplicifolia	Euphorbiaceae	Kpome

Fagara xathozilodis	Rutaceae	Kpome
Dichapetalum madagascariense	Rosideae	Kpome
Malotus oppositifolius	Euphorbiaceae	Kpome
Andropogon spp	Poaceae	Kpome
Indigofera spp	Fabaceae	Kpome
Panicum laxum	Poaceae	Avepozo
Sporobolus pyramidalis	Poaceae	Avepozo
Indigofera dendroides	Fabaceae	Avepozo
Crotalaria pallida	Fabaceae	Avepozo
Tephrosia villosa	Fabaceae	Avepozo
Melanthera scandens	Asteraceae	Avepozo
Tephrosia bracteolata	Fabaceae	Avepozo
Piliostigma thonningii	Fabaceae	Badja
Sorghum sp	Poaceae	Badja
Cajanus cajan	Fabaceae	Badja/Adéticope
Alternanthera procumbens	Chenopodiaceae	Badja
Andropogon tectorum	Poaceae	Badja
Eleusine indica	Poaceae	Badja
Paspalum scrobiculatum	Poaceae	Badja

3.3. The forage spectrum of the study area

In the context of our study, the forage spectrum shows a dominance of annual Fabaceae followed by Poaceae over the other forage types at all levels (figure 2). These results agree with those of Amégnaglo and *al*. [16] and Dourma and *al* [5] who claimed that the Fabaceae and Poaceae families dominate the pastures of the Guinean zone of Togo. The fodder wealth in these two families shows that they are the main source of fodder supply for local livestock and transhumant livestock.

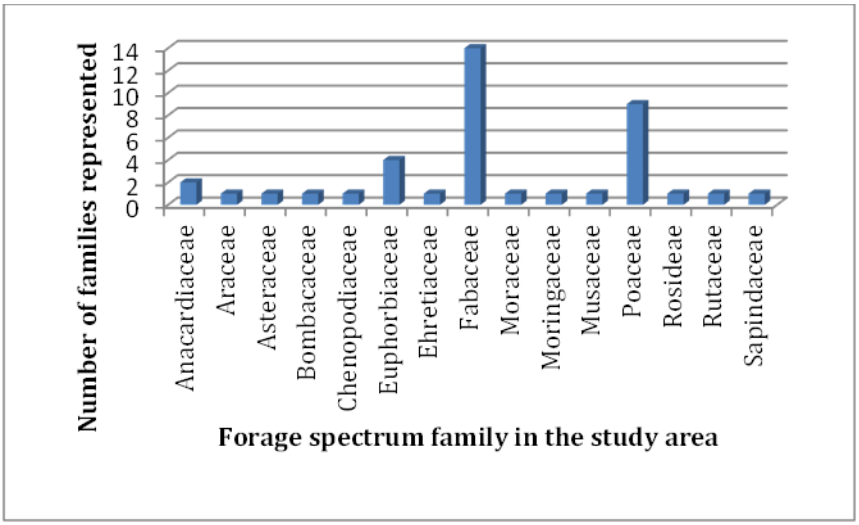

Figure 10 Forage spectrum of the study area

3.4. Some bromatological values of the forages identified

Maximizing the food value of fodder is a key element in limiting the use of complementary foods in animal feed and thus reducing production costs and increasing the food self-sufficiency of ruminant farming systems. The results obtained from the study are presented in Table 2

Table 2 Bromatological value of forage species identified

Scientific name	Moisture content (%)	Ash Content (%)	Fat content (%)	Crude fiber Content (%)	Energy content (UF/Kg of DM)
Acacia melifera	5.5801	8.8747	6.5846	22.0301	091
Adansonia digitata	5.2589	10.5097	2.2246	8.3298	
Albizzia spp	5.3799	5.6227	1.5352	20.9633	0.98
Andropogon spp	6.1633	13.8819	2.2493	17.1871	0.93
Andropogon tectorum	6.3211	5.6052	5.8200	24.8944	0.89
Antiaris Africana	7.1993	16.7247	3.5323	15.5142	0.92
Bridelia ferrugineae	5.6868	7.0186	3.5599	21.4954	0,94
Cordia Africana	4.8848	8.5592	2.8523	8.3305	
Cajanus cajan	5.8823	7.3456	8.1100	14.2362	1.05
Crotalaria pallida	5.8655	12.9276	3.4863	8.1229	
Desmodium tortuosum	6.7095	12.8166	2.5874	10.6784	
Dichapetalum madagascariense	6.4627	8.8379	2.3796	10.129	
Eleusine indica	5.4332	12.9514	2.8700	20.7245	0.89
Fagara xathozilodis	5.8547	9.6578	0.8980	10.1946	
Gliricidia sepium	7.2811	10.6196	3.3622	8.8875	
Griffonia simplicifolia	6.8477	12.4505	1.0969	18.2237	0.93
Imperata cylindrica	6.0601	30.3293	0.8476	8.7011	
Indigofera dendroides	5.9759	15.6818	2.6742	8.4478	
Indigofera spp	5.7557	9.4317	3.5349	17.2243	0.98
Leuceana leucocephala	5.6777	7.5205	3.8061	7.9676	
Malotus oppositifolius	5.2312	9.4666	4.5626	10.6999	
Manguifera indica	5.8937	8.9650	3.1958	19.3168	0.96
Manihot esculenta	4.3888	8.0202	6.1415	8.8719	
Melanthera scandens	6.781	14.8654	3.0852	9.2069	
Moringa oleifera	6.9429	7.4464	4.0380	7.5468	
Mucuna pruriens	6.7223	9.2439	3.3300	15.298	1.03
Musa acuminata	6.2919	11.7349	3.3041	24.6327	0.79
Pannicum maximum	6.5142	10.6267	1.7524	8.5621	
Paullinia pinnata	5.1158	5.0278	2.1420	25.3648	0.88
Paspalum scrobiculatum	6.7223	11.9455	2.9500	15.2584	0.99

Piliostigma thonningii	5,5627	4.9345	5.4100	19.1636	1.01
Pithecellobium dulce	6.4649	8.2122	4.0747	15.7465	1.02
Spondias monbin	9.4301	9.2041	1.9375	18.3007	0.97
Sorghum spp	6.9852	8.4117	3.4100	16.4231	1.02
Sporobolus pyramidalis	5.6995	13.4695	1.4752	19.6329	0.87
Stylochaeton lancifolius	2.2378	7.4988	0.8771	15.5881	1.04
Tephrosia bracteolata	5.8089	10.2004	2.4975	6.0727	
Tephrosia villosa	6.5699	7.8538	3.2422	8.3076	

3.5. Humidity level

Fodder is composed of water and dry matter and according to Suttie [17] the water content varies from about 10% (hay) to 90% (green fodder). The moisture content of the forage species studied varied from 2.23 to 9.43% dry matter. The highest value is recorded for Spondias monbin and the lowest is recorded for Stylochaeton lancifolius. The majority (50%) of fodder has a moisture content that varies between 4 and 6%.

3.6. Ash rate

The ash contents of the forage species identified varied from 1.29 to 30.33% of dry matter. The highest value is recorded for *Imperata cylindrica* and the lowest for *Piliostigma thonningii*. The majority of fodder (48%) has an ash content varying from 5 to 10% of dry matter. These results are comparable to those of Savadogo [18] who obtained values oscillating between 4.1 and 19.2% of dry matter.

3.7. Fat content

Forages represent an important or even unique part of the ration of ruminants and can sometimes contain high levels of polyunsaturated fatty acids. They are therefore an important source of fatty acids to improve the quality of milk and meat. In order to optimize ruminant rations according to fatty acid composition, it is necessary to know the fat content and composition of forages. The fat contents of the forage species studied varied from 0.85 to 8.11% of dry matter. The highest value is recorded for Cajanus cajan and the lowest for Imperata cylindrica. The average is 3.16±1.6% dry matter. The majority of fodder (62%) has a fat content varying between 2 and 4%. These results agree with those of Djaalab [19] who states that lipids represent a very small fraction in fodder (2 to 5%), which explains the lack of interest that is most often given to fats in the diet. ruminants. Indeed, lipids are not major constituents of ruminant feed rations. Most common feeds contain only small amounts and the use of feeds rich in lipids can lead to inhibition of ruminal cellulolysis which is likely to reduce zootechnical performance. This inhibition seems to be linked to a toxic effect of fatty acids on certain cellulolytic bacteria according to Cuvelier and *al*. [20].

3.8. Crude fiber rate

The crude fiber contents of the forage species studied varied from 6.03 to 32.3% dry matter (Figure 6). The highest value is recorded for Alternanthera procumbens and the lowest for Tephrosia bracteolata. The mean is 15.16±6.49. 32% of fodder has a fiber content varying between 15 and 20%. These results agree with those of Yanra [14] who states that the fiber content varies from 15 to 40% depending on the species.

3.9. Energy rate

The energy content of the species studied varied between 0.79 and 1.05 FU/Kg of dry matter. The highest value was recorded for *Cajanus cajan* and the lowest for *Musa acuminata* with an average of 0.95±0.07. The majority of fodder (76%) has an energy content ranging from 0.9 to 1.1 FU/Kg of dry matter. It should be recalled that the energy rate was only obtained for 21 species out of the 38 listed plant species due to the limitation of the Dijkstra algorithm [13]. Indeed, this table did not make it possible to determine the energy rate of species whose fiber rate is below 15%. The results of the present study are superior to those of Renard and *al*. [21] who recorded in the Sudano-Guinean savannahs of Togo a relatively constant energy value of 0.58 FU/Kg of dry matter for volunteers of different ages.

4. Conclusion

The study of the fodder resource potential of natural pastures in the Maritime region of Togo has led to a certain number of results. From monitoring the feeding behavior of oxen on pasture and ethnobotanical surveys of breeders, it appears that about forty forage species are used in cattle feed in the study area. The floristic inventory resulted in 40 valuable plant species for livestock feed, distributed in 14 families. Fabaceae and Poaceae are the most represented. From a bromatological value point of view, the ash content ranges from 1.29 to 30.33% dry matter, the fat content varies from 0.85 to 8.11% DM while the crude fiber oscillate between 6.03 and 32.3% dry matter. The majority of fodder (76%) has an energy content ranging from 0.9 to 1.1 FU/Kg of dry matter.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors have declared that no competing interests exist Bibliographic references

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