*Sudan J. Vet. Res. (2006).* ***21****:* 57-66.
*With 3 tables and 1 figure in the text.*

# Caprine Brucellosis under Different Husbandry Systems in Darfur States, Sudan

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**ملخص البحث**

أجرى المسح المصلى لمرض البروسيليه في عدد 1554 رأساً من الماعز في ولايات دارفور الثلاث. إستخدمت إختبارات البنجال الوردى الصحنى المصلى والمثبت المتمم واللبن الحلقي ومقايسة الامتصاص المناعى التنافسية المرتبط بالانزيم في تشخيص المرض، أما إختبار التلازن المصلي فقد استخدم لتحديد مقاسية الأضداد في الأمصال. لقد وجد المرض بنسب ضئيلة ومتفرقة وهنالك بؤر بنسب عاليه فى الضأن والماعز في ولايتي جنوب وغرب دارفور وفي قطعان الماعز المختلطة بالأبقار المصابة بالمرض والتي شهدت موجات إجهاض عارمة .نسب انتشار المرض في الماعز تحت طرق التربية التقليدية بالولايات دارفور المختلفة وفي الجنسين كانت كألآتي: 14(5.6%) من 251 في المستقرة و 9(6.6%) من 136 في شبه المترحله و 18(5%) من 357 في المترحله و 14(1.7%) من 810 في المشتراه من الأسواق و 35 (2.7%) من 1317 في ولاية جنوب دارفور و 5(3.2%) من 154 في ولاية شمال دارفور و 15(18.1%) من 83 في ولاية غرب دارفور و 15(1.8%) من 815 في الذكور و 40(5.4%) من 749 في الإناث و 55(3.8%) من الجملة 1554 رأساً .الإجهاض نتيجة للمرض كان من الاعراض العامة للمرض حيث إجهضت 13(9.8%) من 132 حاله بلغ عنها . وهناك حاله إحتباس مشيمة اتضح انها موجبة للمرض. كان مستوى الأضداد أعلى في الحالات المرضية الظاهرة بلغت 820 وحدة عالميه في معزة مجهضة و 102.5مل وحدة عالميه/مل في المصابة بإحتباس المشيمة. توصى الدراسه بتطعيم الماعز بلقاح البروسيلا المجهضة العترة S19 ، وبلقاح البروسيلا مليتنسز رف واحد (Rev 1) للتحكم في المرض.

## Summary

**Serological and epizootiological studies on caprine brucellosis were conducted in 1554 goats of different sexes and age in Darfur States. Rose Bengal Plate test (RBPT), Complement Fixation test (CFT), Milk Ring test (MRT) and Competitive ELISA (cELISA) were used for diagnosis of the disease. Serum Agglutination Test (SAT) was used for the determination of antibody titres.**

**The disease was sporadic but there were foci of high prevalence rates in South and West Darfur States in mixed flocks of sheep and goats and in goats kept with cattle harbouring the disease and suffered from waves of abortions.**

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**The prevalence of the disease in different management systems, states and sexes were 14 (5.6%) of 251 sedentary, nine (6.6%) of 136**

**semi-nomadic, 18 (5%) of 357 nomadic 14 (1.7%) of 810 from markets, 35 (2.7%) of 1317 in South Darfur, five (3.2%) of 154 in North Darfur, 15(18.1%) of 83 in West Darfur, 15(1.8%) of 815 males, 40(5.4%) of 739 females and 55(3.8%) of a total of the 1554 goats examined.**

**Abortion attributed to brucellosis was the common clinical manifestation of the disease and it accounted for 13 (9.8%) of 132 reported aborted cases. A nany goat that had suffered from a retained placenta was positive for the disease. SAT antibodies titres were higher in apparent clinical cases and reached 820 IU/ ml in an aborted nany goat and 102.5 IU/ml in a goat that had a retained placenta.**

**Vaccination of goats with *Brucella abortus (B. abortus)* S19 and *Brucella melitensis* Rev. I vaccines is recommended for control of the disease.**

## Introduction

Goat's population in the Sudan was estimated to be about 41 million and 485 thousand head (Anon, 2003). Their major breeding area in the country is Darfur states where they are often raised mixed with sheep and rarely separately. The common husbandry methods are sedentary, semi-nomadic and nomadic. These systems are practised by professional breeders, cattle or camel owners and by villagers.

In western Sudan, goats are the major source of meat. They also supply their owners with milk. In arid and semi-arid zones of the country, goat's milk is one of the major sources of food. Goat trade to the Arabian Peninsula and exportation of their skins to some Asian and European countitute constitute an important component of Sudanese foreign trade.

The major constraints of goats export are diseases, e.g. brucellosis. The disease is prevalent in the Sudan. Earlier, Dafalla and Khan (1958) isolated *B. melitensis* from goats, sheep and cows' milk in Gezira State. Musa and Jahans (1990) isolated the organism from a mixed flock of sheep and goats in South Darfur State. Moreover from Musa (1995) isolated *B. abortus* biovar 6 from cattle fom different areas of western Sudan. The same organism has also been isolated from an aborted nany goat in South Darfur State (Anon, 1992).

This work was designed to study the different aspects of caprine brucellosis in Darfur States under the circumstances described.

## Materials and Methods

Thirteen provinces in South, West and North Darfur States were visited at different times and multistage random sampling was used. Eighty-four milk samples and 1470 sera were collected from 1554 goats raised under different husbandry practice methods for serological diagnosis of brucellosis. One sample was taken from each goat, except the 34 goats that had aborted from which both milk and blood samples were collected .The serum samples were transported on ice boxes to the laboratory and stored in a deep freezer at-20$^{o}$C till tested.

**Serological tests:**

Eighty four milk samples were examined by the milk ring test (MRT). Of 1470 serum samples, 11 were tested by both RBPT and cELISA, 406 plus the 34 from aborted goats by the RBPT, SAT and CFT and 1019 by RBPT and SAT. From the latter serum samples, 125 were randomly selected and examined by modified SAT (mSAT) for comparison. Both SAT and the mSAT were used in this study for measurement of antibody titres. Standardized antigens were used for all tests. The RBPT, SAT, CFT and MRT were performed as described by Morgan *et al.* (1978), the mSAT according to Kolar (1989) and cELISA according to the methods of Brew *et al.* (1992).

**Statistical analysis**:

The prevalence rate of the disease in goats of both sexes raised under different management systems in the three states was determined by Chi-square methods of contingency table using SAS statistical programme (SAS, 1996).

## Results

**Serological tests results:**

Fourteen out of the 84 (14.30 %) milk samples were positive for MRT; six of these were from aborted goats .The eleven serum samples were negative for the tests but 28 (6.9%) of the 406 and 13 (1.3%) of the 1019 were positive to the disease. Six (17.6%) of the 34 aborted goats were positive to the disease. Of the six serum samples from the latter goats, five were negative for RBPT, while in one case both milk and serum samples were positive.

**Comparison between SAT and mSAT:**

The mSAT was more sensitive than the SAT . In two samples SAT antibody titre was 13 IU/m1 each, while that of the mSAT was 31 1U/m1 each. In a third sample that of SAT was 36 IU/m1 and mSAT was of 51.5 IU/m1. In a fourth sample both antibody titres of SAT and mSAT were almost equal. In the fifth sample, SAT was negative but mSAT antibody titre was 51.5 iu/m1.

**The disease in different localities:**

The prevalence of the disease in the three states is presented in Table 1.

**El Daein Province:**

Of the seventy-two goats raised tgether with sheep and owned by nomadic cattle owners, positive cases were detected in three flocks; two (11.89%) of 17, one (6.3%) of 16 and two (9.1%) of 22. There were three aborted goats within the positive cases.

**Buram and Tulus Provinces:**

The 174 goats examined were mixed with sheep and managed under nomadic system together with cattle. The goats belonged to several owners from the two provinces and were examined at seven localities along nomadic routes from Bashama, south of Bahar El Arab to Labanti, north of Nyala province. Two positive goats (6.9%) out of 29 were detected in Doma, wheras 2 (2.8%) out of 72 were positive in Labanti (Fig.1).

**Rehaid El birdi and Id El Firsan provinces:**

The 31 goats examined in the two provinces were mixed with sheep and herded with nomadic cattle. There were three positive cases, two aborted nany goats out of five in a flock that witnessed waves of abortion and a third aborted one from another stock of three animals. Both flocks were owned by cattle nomads and SAT antibody titre of one of the aborted goats was 820 IU/ml. Among the goats there were 23 females owned by a camel herder and all aborted but were negative for brucellosis.

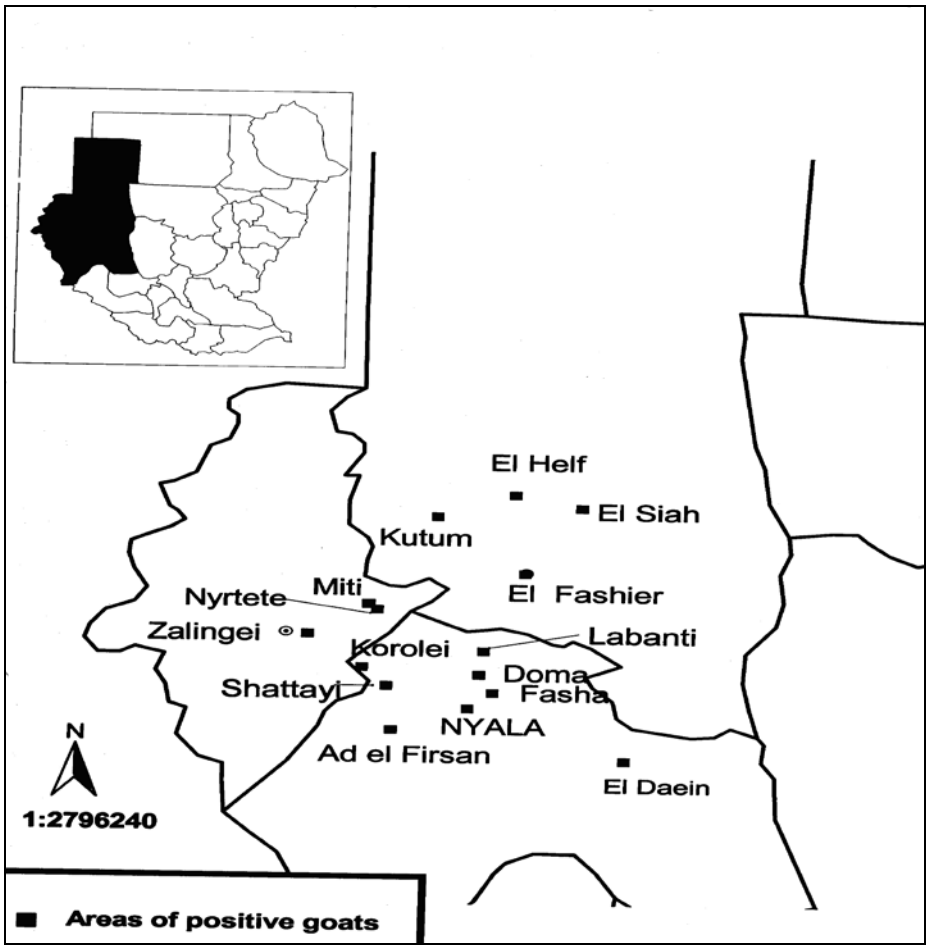


**Fig. 1: Darfur States showing areas of goats positive for brucellosis**

**Nyala Province:**

The 900 goats from Nyala province were from various sources: one hundred ten were bought from Nyala market slaughtered at Nyala abattoir ; eight of them (7.3%) were positive for the disease; seven hundred were billy–goats collected from South and West Darfur States (0.9%) of which six were positive for the disease. Fourty three were sedentary inside Nyala town and two (4.7%) of them were positive including a goat which had a retained placenta and SAT antibody titer of 102.5 IU/ml, and 47 were also sedentary

goats from two villages around Nyala which were negative for brucellosis.

**Shaeria Province:**

The 76 goats examined in the province were mixed with sheep and managed under semi-nomadic conditions. 21goat from Khazan Gadeed, 38 from Mirair and 17 from Fasha. Goats from Khazan and Mirair were negative whereas three goats from Fasha were positive for the disease.

**Kass Province:**

The 64 goats examined were from two localities , Korolei where 17 goats mixed with sheep and reared under semi- nomadic system with cattle were found negative and, 47 from Wadi Kaya that were also mixed with sheep under semi- nomadic system, kept by camel herders and three of them were positive for brucellosis .

**Jabel Marra Province:**

The 40 sedentary goats tested were from three localities; 15 from a mixed farm of cattle, sheep and goats which had witnessed abortion. Of those eight (53.3%) were positive for the disease, including one goat which had aborted twice and its SAT antibody level was 205 IU/ml, out of 11 goats from a mixed flock of sheep and goats in Nyrtete village and of those one, was positive and 14 from (9.1%) a mixed flock of sheep and goats in an isolated area in the same village were negative for the disease.

**Zalingei Province:**

The 43 semi-nomadic goats were kept by cattle owners in two localities; 38 in west of Korolei of which three (7.9%) were positive and five from a small herd in Sirmi, east of Zalingei, where also Three of them (3/5) were positive for brucellosis.

**El Fasher Town:**

Twenty nine sedentary goats were examined in this town were negative for the disease.

**Millit Province:**

Ninety-two sedentary goats examined in two localities; 11 in Madu which were negative and 81, in Alsayah ,three (3.7%) of them were positive for the disease. Seventy of the goats aborted and only 4 (5.7%) were found positive for the disease.

**Kutum Province:**

Thirty-three nomadic goats from two localities were examined, five from Um Baro and which negative and 28 from El Helf, north of Millit, two (7.1%) of them were positive.

Fig. 1 shows areas of brucellosis positive goats. Table 2 shows number of aborted goats associated with the disease. High rates of abortion due to the disease were encountered (15%) in El Daein, and Rehaid El Bridi and Id El Firsan provinces (11.5%). Similar stormy abortions were also observed at Madu in Millit Province but Millit attributed to dehydration where goats usually watered every five days.

**Table 2: Number of aborted nany goats and those positive for brucellosis in the Darfur States**

| State | No. aborted | No. brucellosis positive | % |
|---|---|---|---|
| **South Darfur** | 57 | 8 | 14 |
| **West Darfur** | 6 | 2 | 33.3%* |
| **North Darfur** | 70 | 4 | 5.7 |
| **Total** | **133** | **14** | **10.5** |

* No of cases examined is too small

Table 3 shows the prevalence rates of the disease under the three husbandry pratices and in goats brought to local markets.

**Table 3: Prevalence rates of brucellosis in goats raised under different Management systems in Darfur States.**

| States | Animal Markets | | Sedentary | | Semi-nomadic | | Nomadic | |
|---|---|---|---|---|---|---|---|---|
| | **No. tested** | **No. +ve (%)** | **No. tested** | **No. +ve (%)** | **No. tested** | **No. +ve (%)** | **No. tested** | **No. +ve%** |
| **South Darfur** | 810 | 14 (1.7) | 90 | 2 (2.2) | 93 | 3 (3.2) | 324 | 16 (4.9) |
| **West Darfur** | - | - | 40 | 9 (22.5) | 43 | 6 (14) | - | - |
| **North Darfur** | - | - | 121 | 3 (2.5) | - | - | 633 | 002 (0.3) |
| **Total** | **810** | **14 (1.7)** | **251** | **14 (5.6)** | **136** | **9 (6.6)** | **357** | **18 (5)** |

**Statistical analysis:**

The analysis of the different parameters showed that the results of the prevalence rates of brucellosis under different management systems, states, sexes and in all animals examined were significant ($P \leq 0.001$).

## Discussion

Limited numbers of goats were examined for brucellosis in North and West Darfur States because of many limitations mainly security and financial difficulties, yet the prevalence rates of the disease in the two states were statistically significant. Preliminary account of the disease was given because this was the first study of the disease in goats in wester Sudan and examinations were based on serological diagnosis. According to WHO report (1992), serology remains the mainstay of brucellosis control and eradication throughout the world, and isolation of *Brucella* organisms is used as a confirmatory procedure. According to the report, the conventional serological tests were widely used in various combinations for the diagnosis of brucellosis in animals and their continuity was recommended till 2000. However, RBPT and CFT are still suitable tests for diagnosis of brucellosis although indirect ELISA, cELISA and fluorescent polarisation assay (FPA) are now widely used and preferred because of their technical simplicity and superioity to CFT (IE, 2000). Unfortunately, it was not possilble to use ELISA tests because they were unaffordable and cELISA was used for the 11 samples together with others from cattle, sheep and camels. The isolations of *B. melitensis* and *B. abortus* from caprines and other species in western Sudan, and the high antibody titres found in clinical cases in the study confirmed the serological tests results. Musa (2005) reported the prevalence of brucellosis in sheep in the same flocks or localities where the disease was also found in goats in this study. Goats are primary hosts of *B. melitensis* and susceptible to *B. abortus*. However, Young and Corbel (1989) believed that *B. abortus* in goats is less frequently recorded. The occurrence of brucellosis in mixed flocks of sheep and goats could be attributed mainly to *B. melitensis* as was reported previously (Musa and Jahans, 1990). Further research to reveal the role of each *Brucella* species in goat and sheep brucellosis is clearly warranted.

Serum Agglutination test (SAT) is not a reliable diagnostic test for brucellosis because it has many limitations (Herr *et al*., 1982; MacMillan 1990) and it was used in this study for the determination of anti-brucella antibodies and as an aid to RBPT in circumistances where other confirmatory tests were not available. The mSAT was used to improve SAT results, because it abrogates prozone phenomenon due to high concentration of 1gG (Kolar, 1989).

The Milk Ring test was found positive in circumistances where RBPT or SAT were negative. Morgan *et al*. (1978) observed such a phenomenon, where MRT was positive but SAT was negative

The situation of brucellosis in most areas of study and the overall prevalence rates indicate that the disease is sporadic; similar work has previously been published (El Nasri, 1960; Adlan and Osman, 1986; Fayza *et al*., 1990). However, the high prevalence rates of the disease in certain localities and the intensive turnover of animals in all directions could disseminate the causative agent among different animal species. This oncoming situation threatens animal health, economy and food security for the people of Darfur states..

The fact that 89.5% of the aborted nany goats were negative for brucellosis, necessitates further research to investigate other causes of abortion. Since goats were found infected with both *B. melitemsis* and *B. abortus*, vaccination of sheep and goats with *B. melitenisis* Rev. 1 vaccine is important in areas where the organism prevails, and with *B. abortus* S19 vaccine together with cattle in places where cattle are infected with *B. abortus.*

**Acknowledgements**

I would like to thank Mr A. A. Suliman for his laboratory technical help. Thanks are also due to Mr S. A. Neoga for his technical assistance. I am also grateful to Dr. Bothina A. Ibrahim for her travel with us to North Darfur State to collect samples and for her assistance during the work in South Darfur state.

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**Table 1: Prevalence rates of brucellosis in goats of both sexes in different provinces in Darfur states, Sudan.**