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Experimental infection of Red Sokoto goats with *Salmonella typhimurium*

OTESILE (E.B.), AHMED (G.), ADETOSOYE (A.I.). Infection expérimentale par *Salmonella typhimurium* sur des chèvres Rousse de Sokoto. *Revue Élev. Méd. vét. Pays trop.*, 1990, 43 (1) : 49-53.

Une infection expérimentale à *Salmonella typhimurium* a été provoquée expérimentalement chez des chèvres par administration orale de 2×10^{10} organismes. La maladie s'est manifestée par de la fièvre, de la diarrhée et une leucocytose à neutrophiles. Une chèvre est morte de septicémie. Des agglutinines somatiques de type « 0 » ont été décelées dès le 14^e jour de l'infection et l'excrétion des salmonelles dans les fèces a cessé 6 semaines après l'infection. Les chèvres qui ont surmonté l'infection primaire ont résisté à une deuxième épreuve avec 2×10^{11} organismes. Les résultats montrent qu'en l'absence de signes cliniques de mauvaise santé, la détection des neutrophiles et des agglutinines « 0 », et l'isolation des salmonelles à partir des fèces constituent la preuve d'une infection récente. *Mots clés* : Chèvre - Salmonellose - *Salmonella typhimurium* - Infection expérimentale - Nigeria.

INTRODUCTION

Salmonellosis are important in animal production (1) and some of them play a major role for public health (2). They constitute an important aetiology of septicaemia and diarrhoea in domestic animals and man (1, 6). While much studies have been carried out on this subject in cattle (13) and to a lesser extent in sheep (3), there remains a paucity of information on salmonellosis in goats. This may be because goats are relatively more resistant to the disease so that fewer natural outbreaks occur compared to cattle and sheep. However, since goats are mainly important in the economy of developing and poor countries, the cost of establishing the identity of *Salmonella* serotypes might have dissuaded authors from carrying out relevant investigations despite possible economic and public health problems in relation with the disease.

According to a study on diseases of goats in Nigeria, bacterial enteritis were responsible for 16.2% of all deaths (12). The isolation of *Salmonella* organisms

from diarrhoeic Nigerian goats (7) suggests that salmonellosis contributes to caprine enteritis in this country. This study was therefore intended to investigate the response of a Nigerian goat breed, Red Sokoto, to experimental infection with *Salmonella typhimurium*. It is hoped that the information gathered will contribute to establishing a clinical diagnosis of the disease in goats.

MATERIALS AND METHODS

Experimental animals

Eight male Red Sokoto goats, aged 9-12 months, were used for the studies. They were screened and found to be negative for *Salmonella* organisms and for somatic « 0 » agglutinins before experimental infection.

Bacterial strain

Salmonella typhimurium phage type 204, originally isolated from a natural infection in calves, was used for the studies.

Experimental design

In the primary infection, each of 6 goats received orally a 10 ml suspension containing 2×10^9 organisms/ml. Two goats served as uninfected controls. In the secondary (challenge) infection which took place 7 weeks after the primary infection, each of five goats was given a 20 ml suspension containing 2×10^{10} organisms/ml. The goats rectal temperatures were recorded daily and signs of ill-health noted daily. Blood was collected aseptically from the goats jugular veins for haematology, serology and bacteriology. About 3 g of faeces were collected from the rectum of each goat for bacteriology. Total red and white blood cell counts were made with a Coulter while differential leucocyte counts were estimated after staining blood smears with Giemsa.

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E.B. Otesile, G. Ahmed, A.I. Adetosoye

Bacteriology

Blood or faecal samples were thoroughly mixed and a portion streaked into McConkey agar. The plates were then incubated at 37 °C for 24 h. The identity of non-lactose fermenting colonies was confirmed by slide agglutination test using specific *S. typhimurium* anti-serum (Wellcome).

Serology

Slide agglutination test was performed on goat serum samples using pure colonies of *S. typhimurium* grown on Nutrient agar, as antigen. Tube agglutination test was done to determine somatic « 0 » agglutinin titres of serum samples which showed agglutination when mixed with *S. typhimurium* antigen in slide agglutination test. For tube agglutination test, Salmonella « 0 » antigens were prepared as described elsewhere (5). The agglutination test was set up as previously described (4). The sample was incubated at 37 °C for 4 h followed by overnight incubation in the refrigerator. The results were read as described (4).

RESULTS

Clinical findings

A rise in rectal temperature of infected goats was detected from one day post infection (p.i.), reached a peak by 3 days p.i. and returned to within normal range by 7 days p.i. (Fig. 1). Infected goats appeared dull and did not finish their usual ration during the period of pyrexia (1 to 4 days p.i.). One infected goat died 3 days p.i.

The faeces of the other goats remained well formed (pelleted) up to 2 days p.i., became pasty by 3 days p.i. and was very loose and foul smelling by 4 days p.i. By 8 days p.i., the faeces of the five goats returned to the normal pelleted form. The five goats survived the period of the experiment.

Bacteriology

Salmonella typhimurium was isolated only on day 2 p.i. from the blood of two of the six infected goats. One of the two goats died the following day. Excretion of *S. typhimurium* in faeces was first detected 2 to 7 days p.i. (mean 4.0 ± 2.1 days p.i.). The duration of faecal excretion varied among infected goats: while one animal was positive 3 to 35 days p.i., organisms were detected only on days 7 and 14 p.i. in another

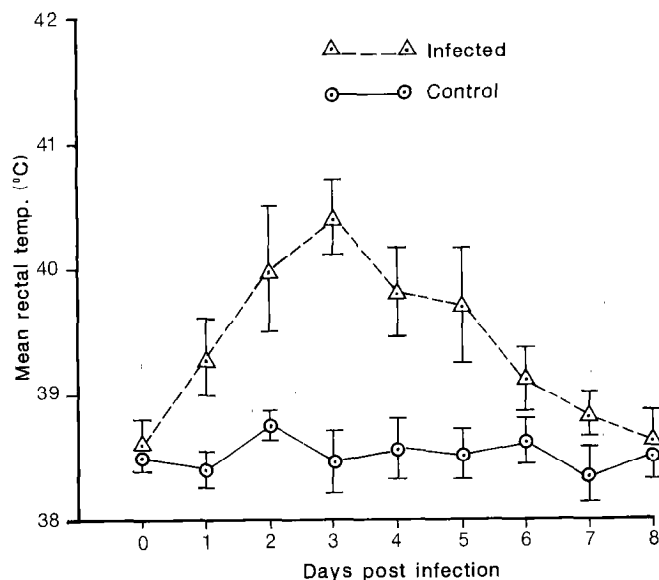


Fig. 1: Rectal temperatures of goats infected with *S. typhimurium*.

one. Three goats had continuous excretions while in two others excretions were intermittent. Organisms were not detected in the faeces of any of the goats by 6 weeks p.i.

Haematology

There were no significant changes in the red blood cell values of the goats. Total WBC count rose 4 days p.i., the increase being mainly due to a rise in mean neutrophil count from $6.4 \pm 1.5 \times 10^9/L$ on day 0 to $16.5 \times 10^9/L$ 7 days p.i. (Fig. 2). Leucocytosis persisted until 49 days p.i.

Serology

None of the serum samples collected on the days 0 and 7 agglutinated *S. typhimurium* organisms on slide. Positive slide agglutination was detected in all infected goats 14 days p.i. Tube agglutination test gave somatic « 0 » agglutinin titres of 80-160 14 days p.i. (mean (120 ± 46)) rising to 640-1.280 (mean 896 ± 350) 35 days p.i.

Post mortem findings

The main gross lesion observed at necropsy in the dead goat was necrosis of abomasal mucosa; the necrotic area being about 3.2 cm x 2 cm. The small

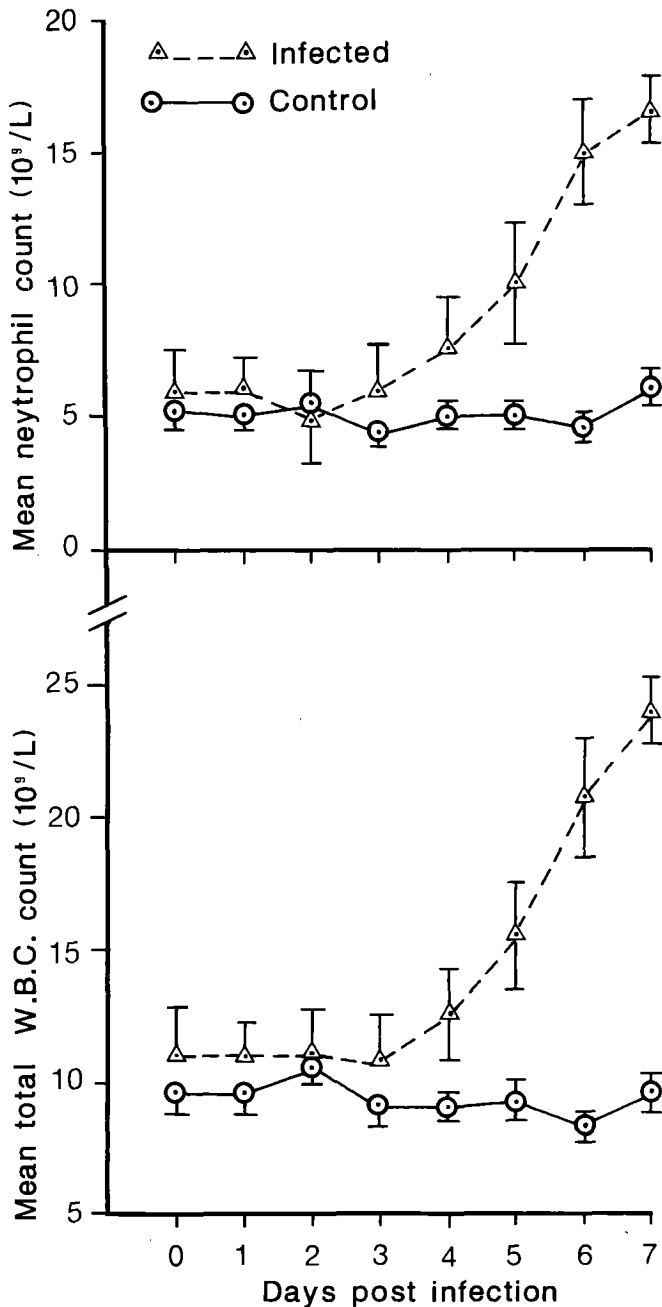


Fig. 2 : Total W.B.C. and neutrophil counts of goats infected with *S. typhimurium*.

intestine and mesenteric lymph glands were hyperaemic. The apical lobe of the right lung was hyperaemic and consolidated. *Salmonella typhimurium* was isolated from the lungs, small intestine, liver, spleen and mesenteric lymph glands of the goat.

Goats response to secondary infection

Following secondary infection of surviving goats with 2×10^{11} *S. typhimurium* organisms, no signs of illness were observed except a transient rise in rectal temperature 2 days p.i. Organisms were not detected in the blood but all goats shed organisms in faeces intermittently from 2 to 6 days up to 21 days post challenge.

DISCUSSION

The clinical signs and *post mortem* lesions observed in goats in this study generally confirm those described for *S. typhimurium* in cattle (10) and in sheep (3, 11). However, the disease was not very severe except in one goat which died of a septicaemic form of the disease. The relative mildness of the disease might be due to an insufficient dose level (2×10^{10} organisms) used for primary infection or to the strain not being very pathogenic. Alternatively, it may be that goats are relatively more resistant to infection than cattle and sheep. Thus a worker in Northern Nigeria (9) was unable to isolate Salmonellae from the systemic organs of over 390 goats examined and detected no carrier state in goats whereas cattle and some other animals commonly suffered from salmonellosis in the same environment.

As previously observed in *S. typhimurium* infection in cattle (14) and sheep (8), after recovery, all goats had completely eliminated organisms by 42 days p.i. suggesting that the clinical disease was not transformed

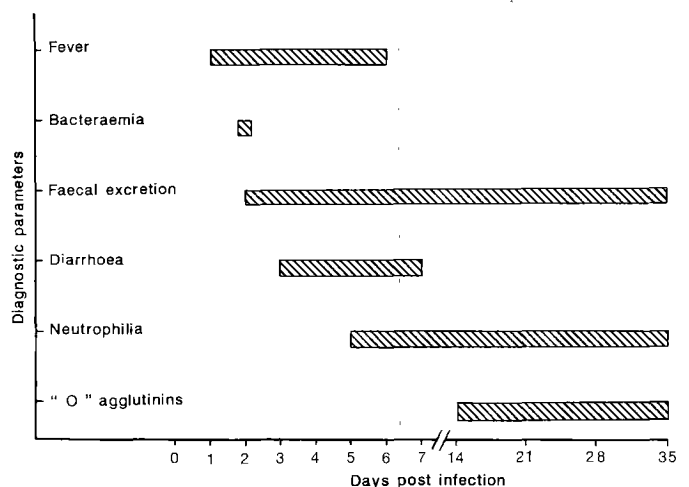


Fig. 3 : Time sequence of detection of diagnostic parameters in goats infected with *S. typhimurium*.

E.B. Otesile, G.Ahmed, A.I. Adetosoye

into an active carrier state. Challenge of goats, which survived primary infection with 2×10^{11} organisms did not result in clinical disease, indicating that the animals had developed immunity following primary infection.

The time sequence of detection of parameters associated with salmonellosis is presented in figure 3. It can be seen that fever, isolation of organisms (from blood and faeces), diarrhoea and neutrophilia were all observed during the stage of clinical disease. A combination of these parameters may thus be considered to be suggestive of clinical salmonellosis. However, faecal excretion of organisms and neutrophilia persisted beyond the stage of clinical disease. Thus, when detected in the absence of signs of ill-health, they may

only serve as an indicator of recent infection. Also, since somatic « 0 » agglutinins were not detected until the clinical disease, it seems that this form of serology may not be useful in the diagnosis of clinical disease, but can mainly serve as an evidence of recent infection.

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OTESILE (E.B.), AHMED (G.), ADETOSOYE (A.I.). Infección experimental de cabras rojas Sokoto con *Salmonella typhimurium*. *Revue Elev. Méd. vét. Pays trop.*, 1990, 43 (1) : 49-53.

La infección experimental con *Salmonella typhimurium* se indujo en cabras mediante la administración de 2×10^{10} organismos *per os*. La enfermedad resultante estuvo caracterizada por pirexia, diarrea y neutrofilia. Una cabra murió de septicemia. Catorce días post infección (p.i.) se detectaron aglutininas somáticas « 0 ». La excreción de organismos en las heces cesó 6 semanas p.i. Aquellas cabras que se recuperaron de la infección primaria, se mostraron refractarias a una segunda infección con 2×10^{11} organismos. Los resultados demuestran que en ausencia de signos de enfermedad, la detección de neutrofilia y aglutininas « 0 », lo mismo que el aislamiento de organismos de *Salmonella typhimurium* en heces, sirven principalmente como evidencia de infección reciente. *Palabras claves*: Cabra - Salmonelosis - *Salmonella typhimurium* - Infección experimental - Nigeria.

OTESILE (E.B.), AHMED (G.), ADETOSOYE (A.I.). Experimental infection of Red Sokoto goats with *Salmonella typhimurium*. *Revue Elev. Méd. vét. Pays trop.*, 1990, 43 (1) : 49-53.

Salmonella typhimurium infection was experimentally induced in goats by administering 2×10^{10} organisms *per os*. The disease produced was characterized by pyrexia, diarrhoea and neutrophilia. One goat died from septicaemia. Somatic « 0 » agglutinins were detected 14 days post infection (p.i.). Excretion of organisms in faeces ceased by 6 weeks p.i. Goats which recovered from primary infection were refractory to a secondary challenge with 2×10^{11} organisms. The results indicate that in the absence of signs of ill-health, the detection of neutrophilia and « 0 » agglutinins and isolation of *Salmonella* organisms from faeces mainly served as evidence of recent infection. *Key words*: Goat - Salmonellosis - *Salmonella typhimurium* - Experimental infection - Nigeria.

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