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Carrier rate of salmonellas in sheep and goats and its public health significance

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SUMMARY

To find out the salmonella carrier rate, 5980 samples comprising faeces, mesenteric lymph nodes, liver and spleen were collected from 812 sheep and 683 goats slaughtered for food. In all 72 salmonella strains from 51 animals (25 sheep and 26 goats) were isolated. These represented 22 salmonella serotypes. The public health significance of these findings is discussed.

INTRODUCTION

The dissemination of the members of genus *Salmonella* from infected carcasses is a proven route of human infection (Thomsett, 1963). Surprisingly there are few reports from India on the carrier-rate of salmonellas in animals used for human consumption (Kumar, 1964). The present study was undertaken to define the carrier-rate of salmonellas in sheep and goats, slaughtered for food, at Mhow, Central India.

As salmonellosis is primarily an enteric infection and faeces are often responsible for contamination of other carcasses in unhygienic abattoirs, an examination of faecal samples was undertaken. During their course of spread from the intestines to other parts of the body, salmonellas may be trapped in mesenteric lymph nodes, liver and spleen and therefore these organs were also examined in this study.

MATERIALS AND METHODS

Collection of specimens

Faeces, mesenteric lymph nodes, liver and spleen were cultured from each of 812 sheep and 683 goats. Soon after slaughter, 1–2 g. of faeces was collected from the distal part of the large intestine. Approximately 1 g. each of liver and spleen was collected aseptically in separate sterile test tubes. Three to five lymph nodes draining the small and large intestines were collected.

Culture of specimens

Within 1 hr. of collection the specimens were brought to the laboratory and 10 ml. of tetrathionate broth was added. Lymph nodes, livers and spleens were cut into small pieces before adding the enrichment medium. Tubes were incubated for

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Table 1. *Source of* Salmonella *serotypes isolated from* 25 *sheep and* 26 *goats*

	Sheep*				Goats			
Salmonella serotype	Faeces	Lymph node	Liver	Spleen	Faeces	Lymph node	Liver	Spleen
S. aberdeen	−	+	−	−				
S. adelaide	−	+	−	−	−	+	−	−
S. anatum	+	−	−	−	+	+	−	−
	+	−	−	−	+	+	+	+
	+	−	−	−	+	+	−	−
S. bareilly	+	−	−	−				
	+	−	−	−				
S. bovismorbificans	−	+	+	−	+	+	−	−
S. chester	+	−	−	−	+	−	−	−
					+	−	−	−
S. choleraesuis	+	−	−	−				
S. derby	−	+	−	−	+	−	−	−
	−	+	−	−	+	+	−	−
S. dublin	−	+	−	−	+	−	−	−
S. enteritidis	+	−	−	−				
S. fremantle	+	−	−	−				
S. frintrop	−	+	−	−	+	−	−	−
S. london					−	+	−	−
S. oranienburg					+	−	−	−
S. poona					−	+	−	−
S. pullorum	−	+	−	−	+	−	−	−
S. reading	+	+	−	−	+	+	+	−
	+	+	+	−				
S. rostock					+	+	−	−
S. salford					−	+	−	−
S. typhimurium	+	−	−	+	+	+	−	−
	+	−	−	−	+	+	−	−
	+	−	−	−	−	−	+	−
					−	+	−	−
					+	+	+	+
					−	−	+	−
S. virchow					−	+	−	−
S. welterveden	+	−	−	−	+	−	−	−
	+	−	−	−				
Total no. of strains	16	10	2	1	18	16	5	2

* One faecal sample from a sheep, not included in this table, yielded *S. anatum* and *S. dublin*.

30–36 hr. and then plated on MacConkey agar, Salmonella Shigella (S.S.) agar and Brilliant Green (B.G.) agar (Hormaeche & Peluffo, 1959). Suspect salmonella colonies were inoculated in Triple Sugar Iron (T.S.I.) agar. The T.S.I. tubes showing no change or the production of acid were discarded, while the rest were transferred to urease medium. Urease positive cultures were discarded. Urease negative cultures were further tested for indole production and fermentation of the following sugars: arabinose, xylose, glucose, adonitol, dulcitol, sorbitol, mannitol, salicin and inositol. Other biochemical tests performed were nitrate reduction, Voges-Proskauer, gelatin liquifaction, H_2S production, citrate utilization and growth in KCN medium.

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Table 2. *Frequency of isolation of salmonellas from sheep and goats over a seven months period*

Month	No. of animals examined/ No. positive	
	Sheep	Goats
July	121/5	102/6
August	142/6	112/7
September	147/6	85/4
October	136/3	82/6
November	109/2	105/3
December	103/2	112/0
January	54/1	85/0
Total	812/25	683/26

Serological typing

Serological typing of all strains suspected of being *Salmonella* was done by one of the authors (S.K.) at the National Salmonella and Escherichia Centre, India, according to the centre's procedure (Agarwal, 1963).

RESULTS

Twenty-five of the 812 sheep (3·1 %) and 26 of the 683 goats (3·8 %) were found to be salmonella carriers. The total number of strains isolated from all four sources, faeces, liver, spleen and mesenteric lymph nodes was 72, which represented 22 different salmonella serotypes (Table 1).

The differences between the number of positive isolations from male and female animals of both species were statistically not significant.

The apparent higher number of isolations during the warmer months (Table 2), compared to the colder months of the year was statistically insignificant.

The number of isolations was higher from older than from younger animals.

DISCUSSION

The present study revealed that 3·1 % of sheep and 3·8 % of goats were carrying salmonellas. These findings are similar to those of Zwart (1962) in Ghana and Sharma & Singh (1961) in India but differed from workers in England and America who failed to demonstrate any salmonellas in sheep (Smith & Buxton, 1951; Mann, 1963). *S. typhimurium* was the commonest of all the salmonella serotypes recorded in the present study; its frequency of isolation was higher in goats (6) than in sheep (3).

The higher number of isolations from older animals, compared to younger animals, irrespective of species and sex, confirm earlier reports (Edwards, Bruner & Moran, 1948; Buxton, 1957; Salisbury, 1958; Moore, Rothenbacher, Bennett & Barner, 1962). In two young goats, salmonellas were recovered from all the four samples collected from each animal. These results extend the previous findings (Buxton, 1957; Edwards *et al.* 1948) that septicaemic infections are more frequent

in younger animals – the so-called 'doctrine of Montevideo' (Vaccaro, Perez & Fincheira, 1945).

On one occasion, two salmonella serotypes (*S. anatum* and *S. dublin*), were recovered from a single faecal sample of a sheep. Such multiple infections have been observed both in man (Juenkar 1945; Gulasekharam, Velaudapillai & Sabanathan, 1961) and in animals (Edwards *et al.* 1948; Buxton, 1957).

The isolations, especially of salmonella serotypes that have been incriminated in human food poisoning, are of great public health importance as illness due to these organisms is very common in India (Agarwal, 1963). Infected carcasses may contaminate other carcasses or animals during the dressing operations, in transportation or at the butcher's shop, etc. (Camps, 1947; McDonagh & Smith, 1958). Thus a large population including persons such as butchers, veterinarians and those involved in the trade of animal by-products will be exposed to the risk of salmonella infections.

The direct method of infection involves people who eat such uncooked or partially cooked meat which in India is usually from sheep and goats. In this connexion, Khan (1961) stated that in some countries liver of sheep and goats is mixed with bile and eaten raw. In the course of the present study it was observed that the Banjara tribe collected blood from the slaughterhouse for human consumption, a custom which is obviously fraught with danger.

In India, pets such as dogs and cats are often offered raw offal. Similarly, pigs who act as scavengers can pick up the infection from the excreta of infected animals or from their carcasses and may consequently transmit the disease to man, with or without themselves suffering from the infection. It is not unusual to offer the offal or blood of slaughtered animals to poultry in India.

Indirect agents such as flies, cockroaches, fleas and ticks may also aid in the transmission of infections from these sources (Eskey, Prince & Fuller, 1949; Graffer & Mertens, 1950; Gerberich, 1952).

The fact that over 3% of sheep and goats were found to be infected in this investigation indicates that these carcasses may cause human infection. However, the precise investigation of the relationship between such a potential source and the occurrence of human disease requires that salmonellas should be 'fingerprinted' by phage typing.

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