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INVESTIGATION OF THE PRESENCE OF SALMONELLA IN TWO NIGERIAN MEAT PACKING PLANTS

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Summary

Two large and very well established meat processing plants supervised by the Veterinary Public Health Department were examined to assess the incidence of Salmonella within the premises and on the processed carcasses. The overall incidence was 65 out of the 252 samples or 25.9%. Salmonella was found in forty-one of 167 samples (25%) in one and twenty-four out of eighty-five samples (29%) in the other. The high incidence shows a high degree of probability of contamination of the products from both plants. The public health significance of the findings is emphasized and control problems are highlighted.

Résumé

Deux grands complexes convenablement équipés pour le traitement des viandes, contrôlés par le département de Médecine Veterinaire préventive, ont été examinés. L'étude a eu pour objet de définir l'incidence de Salmonella aussilien dans les installations que sur les carcasses d'animaux á transformer. L'incidence globale n'est chiffrée á soixante-cinq échantillons sur les 252 prélevés, soit un taux de contamination de 25.9%. Salmonella a été identifié dans 41 des 167 échantillons provenant d'un complexe (25%) puis dans 24 des 85 échantillons de l'autre (29%).

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Cette incidence élevée de Salmonella indigue la possibilité mon moins grande d'une contamination des produits au niveau des deux installations. La portée sanitaire de ces trouvailles est mise en exergue et les problèmes du contrôle d'hygiène et de salubrité ainsi mis au jour.

Introduction

Microbial food-poisoning in humans is commonly associated with microorganisms originating from animal sources. In some of such cases infection is contracted by eating contaminated meat and meat products. Such contamination occurs within the slaughter-house and during the processing and handling of meat before sale.

The genus Salmonella is one of the more common causes of infectious food poisoning in man. Animal products are recognized to be the most important source of salmonellosis for man (Watson, 1975). Salmonella contamination of fresh meat is an international problem because of exportation of meat and meat products from one country to another (Pross & Riemann, 1967; Schothorst & Kampelmacher, 1967). Reports of Salmonella incidence in meat in Nigeria are few and those available are limited to reports on slaughter slabs or small abattoirs in which animals are slaughtered daily and meat distributed or sold in markets to the population immediately surrounding the slabs of abattoirs (Collard & Sen, 1960). Incidence of Salmonella in well established meat plants which supply meat and meat products on a wider scale to the country population and the neighbouring countries has not been investigated.

The investigation described here was designed to determine the degree of Salmonella

contamination of the two important meat plants in Nigeria and therefore the possibility of contamination of the products of the slaughtered animals.

Background

The Bauchi meat plant

This meat plant came into production in 1968. It was jointly owned by the Federal Ministry of Industry of Nigeria, the North Eastern State Government of Nigeria and the Bauchi Local Authority. The ownership and function of the plant were however transferred to the National Livestock Production in November 1977. Operations in the plant include chilling of dressed carcasses and transporting them to other parts of the country in cold train wagons or trucks. In addition, sausage meat, minced beef, bone meal, tallow (melted fat) and canned products such as corned beef and dog food are made in the plant. All the operations in the plant are supervised by the officials of the Public Health Department of Nigeria.

The Ahmadu Bello University (ABU) meat plant

This is a smaller plant established by the University as a unit in the Department of Animal Science. Operations in the plant are not as extensive as in the Bauchi plant. Its dressed carcasses are sold to the people within 40 km of the location.

In addition, the plant produces sausage meat, minced beef and ham. However there is no bone meal, tallow, dog food or any other canned product.

Meat inspection is carried out by the staff of the Department of Veterinary Public Health of the University and used for teaching purposes to the Veterinary Students.

Materials and methods

Origin of animals slaughtered

In the Bauchi plant the animals slaughtered are mainly cattle, but sheep and goats are also slaughtered in large numbers. The Bauchi plant is attached to nearby government cattle ranches from where the cattle slaughtered originate. A

large number of these slaughtered animals are, however, bought through contractors who obtain them from nearby livestock owners or otherwise travel far into neighbouring countries to buy animals for slaughter.

In the Ahmadu Bello University plant, cattle, sheep, goats, chickens and pigs are slaughtered in very large numbers. Animals originate from several different sources among which are Local and State Government farms and culled animals from various experimental projects at the University and Research Institutes.

Most of the cattle, sheep and goats however come from herdsmen within the Northern States of Nigeria and the neighbouring countries, Chad, Niger and Cameroon. The animals from the nearby Research Institutes and government farms arrive in trucks or are driven on hoof a few hours before slaughter. Others are driven to plants and are held in paddocks and pens for a day or two before slaughter.

Sampling

Cotton swab applicators were made with generous amounts of cotton wool and then sterilized. Materials were sampled by rubbing a swab, moistened with sterile phosphate buffered saline (PBS) over specific areas. The swabs were then placed in 10 ml of transport medium (Difco Laboratories, Detroit, Michigan U.S.A.) and transported to the laboratory in ice boxes. Faecal samples were taken with a sterile wooden tongue depressor and put into sterile sample bottles. Fluid samples were taken by sterile Pasteur pipettes and put into sterile sample bottles.

Bacteriological examination

In the laboratory, 1 ml of the transport medium was added to 15 ml of selenite enrichment broth. The broths were incubated for 48 hr at 37°C after which subcultures were made into brilliant green agar (BGA) Salmonella-Shigella agar (SSA) and MacConkey agar (MA). Plates were incubated for 18–24 hr at 37°C and then examined for typical salmonella colonies on the media (Anon, 1971). Suspected colonies from the plates were transferred to fresh plates for pure growth. Isolates were tested biochemically according to standard methods (King, 1972; Carter, 1973).

TABLE 1. Sites in the Bauchi meat processing plant from which Salmonella was isolated

Location		Results	
General	Specific	No. sampled	No. positive
Holding pen	Faecal material	3	1
	Liquid off floor	1	1
	Water hose	1	-
Weighing scale	Tap water	2	1
	Faecal material	1	-
Alley way	Liquid off floor	1	-
	Walls	2	-
Killing room	Floor	1	1
	Walls	4	1
Killing room	Doors	3	1
	Drains	6	1
	Liquid off floor	4	1*
	Faecal material	3	1
	Washing basins	8	1
	Workers' boots	3	1
Hoisting area	Trolleys & Hooks	12	3
	Organ racks	6	2
	Drain	1	1
Inspection area	Knives	6	2
	Trays	6	1
	Washing basins	5	1
	Organ basins	7	2
Chill room 1	Organ racks	9	3
	Door	1	-
	Walls	2	1
Chill room 2	Floor	1	-
	Basins	4	1
	Door	1	1
Chill room 3	Walls	1	-
	Floor	1	-
	Door	1	-
Cutting area	Walls	4	-
	Floor	1	-
	Basins	2	-
	Knives	4	-
	Saws	3	1
	Packing table	4	1
	Liquid off floor	1	-
	Meat on table	4	1
	Bones on table	4	-
	Packing plastic bags	1	-
Carcass in chill room	Half outside	3	1
	Half inside	3	-
	Heads (cut surface)	6	2
	Peritoneal offals	6	4
	Thoracic offals	6	1
Total		167	41

* One sample contained two serotypes.

TABLE 2. Sites in Ahmadu Bello University meat processing laboratory from which Salmonella was isolated

Location		Results	
General	Specific	No. sampled	No. positive
Holding pen	Faecal material	2	-
	Liquid off floor	1	1
Weighing scale	Faecal material	1	-
	Liquid off floor	1	-
Alley way	Wooden fence	2	-
	Liquid off floor	1	1
Killing room	Door	1	-
	Walls	2	-
Killing room	Liquid off floor	3	1
	Drains	2	1
	Faecal material	1	-
	Washing basins	6	2
	Workers' coats	2	-
	Workers' aprons	2	-
Hoisting area	Workers' boots	4	1
	Hoisting hooks	1	-
	Organ racks	4	1
	Knives	3	-
Chill room 1	Trays	2	1
	Door	1	1
	Walls	4	1
Chill room 2	Floor	1	1
	Offal basins	4	2
	Door	1	-
Cutting area	Walls	2	1
	Floor	1	1
	Offal basins	6	2
Carcass in chillroom	Saw	2	1
	Knives	4	1
	Packing table	2	1
	Liquid off floor	2	1
	Meat on table	2	-
Carcass in chillroom	Half outside	2	-
	Half inside	2	1
	Heads	2	-
	Peritoneal offals	2	1
	Thoracic offals	2	-
	Skin	2	1
Total		85	25

Those confirmed as *Salmonella* biochemically were serotyped using Difco (Difco Laboratories, Detroit, U.S.A.) and Wellcome (Wellcome Nigeria Ltd, Ikeja, Nigeria) antiserum.

Results

Table 1 shows the results from the Bauchi meat processing plant. Data in Table 2 show the *Salmonella* contamination of the ABU meat processing laboratory. The results show that both plants in which meat is processed on a large scale for a large population of Nigeria are severely contaminated with *Salmonella*.

A total of forty-one (25%) of 167 specimens collected at the Bauchi plant contained *Salmonella* while twenty-four (29%) out of eighty-five collected at the ABU plant contained *Salmonella*. One sample collected at the Bauchi plant contained two serotypes. There was no significant difference ($P < 0.5$) in the degrees of contamination of both plants. The degrees of sanitation in both plants were apparently similar although the number of staff in the Bauchi plant was about 17 times that of the ABU plant on the sampling days.

Table 3 shows the serotypes of *Salmonella* isolated and the frequency of isolation from the total number of samples examined. *S. give*, *S. anatum* and *S. colindale* were the most common. *S. poona* was reported for the first time in Nigeria.

Table 4 indicates frequency of isolation from

TABLE 3. Serotypes of *Salmonella* isolated from two Nigerian meat plants

Serotype	Isolation frequency per total number of samples (n=252)	Frequency per total serotypes isolated (n=67)
<i>Salmonella give</i>	19 (7.5)*	19 (28.0)*
<i>S. anatum</i>	15 (6.0)	15 (22.0)
<i>S. colindale</i>	12 (4.8)	12 (18.0)
<i>S. derby</i>	5 (2.0)	5 (7.5)
<i>S. oranienburg</i>	4 (1.6)	4 (6.0)
<i>S. montevideo</i>	3 (1.2)	3 (4.5)
<i>S. johannesburg</i>	2 (0.8)	2 (3.0)
<i>S. nchanga</i>	2 (0.8)	2 (3.0)
<i>S. hull</i>	2 (0.8)	2 (3.0)
<i>S. saint-paul</i>	1 (0.4)	1 (1.5)
<i>S. agona</i>	1 (0.4)	1 (1.5)
<i>S. poona</i>	1 (0.4)	1 (1.5)
Total	67 (26.6)	67 (100)

* Percentages in parentheses

TABLE 4. Frequency of isolation of *Salmonella* from five major areas of the two plants

Sample area	Number examined		Number positive		Percentage positive	
	Bauchi	ABU	Bauchi	ABU	Bauchi	ABU
Holding pen and alley way	14	8	4	2	28.6	25.0
Killing area	56	33	13	7	23.2	21.2
Inspection area	33	*	9	*	27.3	*
Storage area	43	32	12	12	27.9	37.5
Cutting area	21	12	3	4	14.3	33.3
Total	167	85	41	25	24.6	29.4

* Inspection is carried out in the killing area.

major areas of operation *viz.*, killing, storage, cutting and inspection areas. All operating areas appeared to be significantly contaminated.

Discussion

Salmonellosis is the most important of the public health and animal health disease problems (Hobbs, 1961). It remains the most common infectious disease transmitted by food, and animal products are recognized as being the most important source of such infection for man (Galton & Newell, 1960; Prost & Riemann, 1967; Watson, 1975).

Felsenfeld, Young & Yoshimura (1950) were among the early investigators of animal products as a source of infection. Since then several other workers have shown the significance of meat and meat products as important instruments of Salmonellosis in humans (McDonagh & Smith, 1958; Schothorst & Kampelmacher, 1967; Meara, 1973).

The results of the work reported here compare very favourably with those of previous workers on the role of meat and meat products as sources of infection for man. The results show a high incidence of *Salmonella* in the environment although not higher than has been seen elsewhere (Galton *et al.*, 1954). The importance, however, is in the use of these meat plants as a source of raw and processed meat such as sausage meat, minced beef, corned beef, tallow, bone and dog meals, for a large part of the country. *Salmonella* could therefore be spread over a wide area of the country and into many homes by these products. The effluents from the plants also seem to be important. This environmental con-

tamination should also be a concern in public health and epidemiology of salmonellosis. Several workers (Galton *et al.*, 1954; Hrubant, Daugherty & Rhodes, 1972; Rhodes & Hrubant, 1972) have shown the significance of packing plant or feed lot run-offs as a source of environmental contamination and the isolation of *Salmonella* from all the run-off samples in this study also strengthens the findings of these previous investigators.

Only very few *Salmonella* species are host-specific. *Salmonella paratyphi* formerly thought to be host specific for humans has been recovered from cattle many times (George *et al.*, 1972). Thus any salmonella isolated from an animal is a potential pathogen of man. *Salmonella typhimurium* is the most common species involved in human salmonellosis of animal origin but it is interesting that of all the isolates reported here, none was found to be *S. typhimurium*.

Serotypes reported here have been isolated from livestock in the past in Nigeria (Collard & Sen, 1960; Ojo, 1974). *Salmonella poona* is, however, reported for the first time.

It is impossible to avoid slaughtering of salmonella-infected animals and it may not be possible to produce animal carcasses completely free of bacterial contamination. It is however important to point out that care must be taken to minimize contamination of products with faecal materials, skin, gastro-intestinal contents and run-off. Control measures are impossible in these plants at the present time because (1) processing lines move too rapidly for adequate care to prevent contamination; (2) processing equipment is crowded together and inaccessible for proper cleaning during processing; (3) staff movement is indiscriminate and there is a general lack of understanding of proper handling; (4) splashes from drains and run-off easily come into contact with equipment and parts of carcasses and these could go on to contaminate them.

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