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Biochemical and haematological values in abattoir pigs with and without subclinical lesions

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ABSTRACT

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The biochemical and haematological profiles of 379 pigs with or without various gross pathological lesions in an abattoir in Zimbabwe were studied to see whether there were any differences between the levels of haematological and biochemical values, and health status (with and without pathological lesions). On the basis of observable gross pathology, 134 pigs were classified as having one or more subclinical lesions (liver milk spot, pneumonia, pleurisy, pericarditis, abscesses and arthritis). Seventy-six of these were males and 58 females. There were observable sex differences in the mean haematological and biochemical values obtained. Erythrocyte counts showed significant differences in mean values ($P < 0,05$) among groups of pigs found with various pathological lesions. The biochemical values showed significant group differences for ALP, ALT, AST, and LDH.

Keywords: Abbattoir, biochemical, haematological, lesions, pathological, subclinical, values

INTRODUCTION

In a recent study of apparently healthy pigs slaughtered in an abattoir in Zimbabwe, it frequently occurred that a substantial number of carcases showed single or multiple lesions of peritonitis, pericarditis, pneumonia, pleurisy and abscessation (Makinde, Majok, Hill 1993) requiring trimming of the carcase and partial condemnation. Recently Cybulshy, Chan & Morat (1988) and Odink, Smeets, Visser, Sandman & Snijders (1990) found that inflammatory lesions in pigs result in marked changes in haematological and biochemical values.

The aim of this investigation was to compare haematological and biochemical findings in slaughtered pigs in Zimbabwe with and without pathological lesions to determine whether deviations from the normal values/range occurred.

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MATERIALS AND METHODS

The investigation was carried out at a private abattoir that slaughters an average of 600 pigs a day for bacon, pork and pork-meat products. Visits to the abattoir were made twice a week for 8 weeks. All the pigs in four adjacent pens out of the ten pens in the ante mortem room were selected as a convenient sample and those selected per visit came from one or more intensive commercial piggeries. The pigs selected had numbered plastic tags securely tied to their left forelimbs, immediately above their hoofs, so that they could be followed through the processing and carcase-evaluation rooms. Altogether 379 pigs of both sexes and of ages varying from 7 months and above, were used for this investigation. Blood was

collected on the production line by exsanguination into two bottles (one containing 1 mℓ of heparin solution and the other without anticoagulant). The carcases were dressed, washed and opened for examination by the company's meat inspectors who were under veterinary supervision, and also by one of the authors who is a veterinarian. The grossly observable lesions recorded were liver milk spot, pneumonia, pleurisy, pericarditis, abscesses and arthritis. All carcases with one or more of such gross lesions, or without lesions, were matched with their blood samples collected before slaughter. Records did not relate age to specific lesions.

The following haematological parameters were determined on the day of blood collection: erythrocyte and leucocyte counts, leucocyte differential count, haemoglobin and haematocrit. Serum samples were separated by centrifugation and stored at –20°C before analysis. The erythrocyte and leucocyte counts and haematocrit were determined by use of a coulter counter (Coulter, Electronics). Total protein and albumin contents were determined by means of their respective kits, Biuret and bromocresol green, respectively, on an autoanalyser. The following enzyme activities were determined at 37°C by means of their respective kits (Electro-Nucleonics Inc., The Netherlands): alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and lactate dehydrogenase (LDH). Urea, creatinine and cholesterol were determined by means of their respective kits (Electro-Nucleonics Inc., The Netherlands). The serum electrolytes: calcium (Ca^{++}), magnesium (Mg^{++}), phosphorous, sodium (Na^{+}) and potassium (K^{+}) were determined by the principle of ion-selective electrodes by means of Starlyte II (Pharmacia Diagnostics Inc., The Netherlands).

The data were analysed by means of BMDP statistical software, version 1990 (IBM/PC/DOS) (Dixon 1983). In particular, BMDP 7D was used to generate descriptive statistics for the data and to perform one-way analysis of variance (ANOVA) to assess the significance of group difference (at $\alpha = 0,05$). Specifically, one-way ANOVA was used to compare pigs with each of the three most common combinations of lesions, e.g. liver milk spot and pleurisy (one of the two next most common combinations; four groups compared).

RESULTS

Of the 379 pigs examined, 134 had one or more grossly observable lesions. Of these pigs, 76 were males and 58 females (Table 1). Pneumonia (alone and/or in combination) accounted for 20,8% of gross pathological lesions, while liver milk spot was present in 17,4% of the pigs. Other pathological lesions occurring alone and in combination were less than 1% (Table 1). The mean haematological values were higher in the healthy female pigs than the male ones (Table 2).

Only RBC showed significant mean differences ($P < 0,05$) between major combinations of pathology (Table 3). By inspection, pigs with respiratory lesions (pneumonia and pleurisy) had lower RBC counts, decreased Hb and PCV values and increased WBC counts, when compared with pigs that had only milk spot. Gender differences were observed in some of the normal biochemical values in the healthy pigs too; ALP, AST and creatinine, specifically, were higher in the male pigs, while ALT, LDH and cholesterol mean values were higher in the female pigs. Consequently, the activities of ALP and AST were higher in male pigs with pathological lesions than in female pigs of similar pathological status, while the reverse was true for ALT and LDH (Table 4).

The calcium level was higher in the female pigs of both groups than in the male pigs.

DISCUSSION

In this study it is revealed that pneumonia and ascariasis occurred more frequently at subclinical levels in the abattoir pigs; and these agree with our earlier findings of 17,4% (pneumonia) and 16,4% (liver milk spot) (Makinde *et al.* 1993). The mean haematological values either increased or decreased with subclinical pathological lesions and when these values were compared with those of the healthy pigs, the differences were small and within the normal range for pigs, but they became significant with multiple pathological lesions, as shown for example with pneumonia and ascariasis. The marked changes in the haematological values—as shown with leukocytosis, reduced haematocrit, haemoglobin and erythrocyte counts in pigs with inflammatory changes of the lungs and bronchi—are the usual characteristics associated with these diseases (Cybulshy *et al.* 1988).

The mean biochemical values changed similarly with pathological lesions, and these were minimal in total protein, albumin and the electrolytes, but marked in ALP, ALT, AST, LDH, creatinine and cholesterol. Some of these enzymes are liver-specific and therefore serve as index of hepatocellular disorder (Kramer 1989). Ascarid larval migrans induce increases in serum transaminase activities (Kramer, 1989) and this correlates with our observed elevated values in ALP and AST. For instance, ALP as one of the cholestatic enzymes, becomes elevated during cholestasis from either intrahepatic or extrahepatic bile ductular or duct obstructions.

The increase in the ALP activity has been attributed to the overproduction of the hepatic ALP isoenzyme (Cornelius 1989). In the case of AST, it is known not to be organ-specific as, in addition to high concen-

TABLE 1 Classification based on status and sex, of the pigs examined in an abattoir in Zimbabwe ($n = 379$)

Status	Affected pigs		Males		Females	
	n	%	*n*	%	*n*	%
Healthy	245	64,60	141	37,20	104	27,40
Pneumonia only	55	14,50	31	8,20	24	6,30
Milkspot only	33	8,70	19	5,00	14	3,70
Pericarditis only	2	0,53	2	0,53	0	–
Pleurisy only	2	0,52	1	0,26	1	0,26
Milkspot + pneumonia	21	5,50	13	3,40	8	2,10
Milkspot + pleurisy	5	1,36	4	1,10	1	0,26
Milkspot + pericarditis	3	0,79	2	0,53	1	0,26
Pneumonia + pericarditis	3	0,79	1	0,26	2	0,53
Pericarditis + pleurisy	5	1,36	4	1,10	1	0,26
Abscess + arthritis	1	0,26	0	–	1	0,26
Pericarditis + abscess	1	0,26	0	–	1	0,26
Milkspot + arthritis	1	0,26	0	–	1	0,26
Milkspot + pneumonia + pericarditis	2	0,52	1	0,26	1	0,26
Milkspot + pneumonia + pleurisy	1	0,26	0	–	1	0,26
Peritonitis + pleurisy + pericarditis	1	0,26	0	–	1	0,26

TABLE 2 Haematological values of pigs in an abattoir in Zimbabwe, with and without pathological conditions

Haematological characteristic	Males without lesion ($n = 30$)		Males with lesion ($n = 48$)		Females without lesion ($n = 26$)		Females with lesion ($n = 24$)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
RBC x 10/ℓ	6,2	0,9	5,9	1,1	6,6	0,6	6,0	0,9
PCV/ℓ	39,4	6,6	36,9	9,8	44,3	6,2	39,5	8,9
Hb g/dℓ	13,7	1,8	13,1	2,7	14,5	1,7	14,0	2,0
WBC x 10/ℓ	18,1	3,2	23,4	6,1	20,7	4,3	17,8	4,2
MCV fℓ	62,7	5,8	63,5	5,5	65,2	7,4	39,5	8,9
MCH pg	22,7	3,9	22,4	3,0	22,1	1,2	23,3	2,3
MCHC g/dℓ	35,5	6,4	35,1	4,9	33,3	3,1	36,6	6,1
Neutrophils %	52,2	11,0	68,2	9,0	68,3	6,5	67,6	7,1
Lymphocytes %	45,2	11,1	29,0	7,6	29,7	5,9	29,0	6,5
Monocytes %	2,6	1,3	2,0	1,3	15,0	0,7	3,4	2,1
Eosinophils %	2,2	1,3	1,3	0,5	1,2	0,0	1,8	0,5
Band %	2,0	1,4	2,0	0,9	1,5	1,1	2,1	1,0

$\bar{x}$ = Sample mean value
SD = Sample standard deviation

TABLE 3 One-way analyses of variance of haematological values among groups of pigs in Zimbabwe, with various combinations of lesions

Lesions	Haematological values									
	RBC		MCV		PCV		WBC		Hb	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Pneumonia only	5,7	1,1	60,8	3,7	37,1	8,7	21,0	13,1	13,1	2,8
Milk spot only	6,5	1,5	64,9	6,4	40,1	8,2	22,4	7,8	14,6	3,9
Milk spot + pneumonia	5,4	1,3	62,2	10,8	35,7	10,0	22,6	6,0	12,6	3,1
Milk spot + pleurisy	5,7	1,4	60,6	10,4	37,9	9,5	22,1	7,3	12,5	3,0
F-value	3,91		0,31		3,00		0,96		0,99	
df	1		1		1		1		1	
P-value	0,05		0,58		0,09		0,33		0,32	

$\bar{x}$ = Sample mean value
SD = Sample standard deviation

TABLE 4 Biochemical values of pigs with and without pathological conditions, in an abattoir in Zimbabwe

Blood chemistry	Males without lesion ($n = 30$)		Males with lesion ($n = 48$)		Females without lesion ($n = 26$)		Females with lesion ($n = 24$)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Total protein g/ℓ	75,2	5,4	68,4	13,4	71,2	5,2	70,9	10,3
Albumin g/ℓ	46,4	2,8	47,3	10,3	45,7	5,2	43,3	7,5
Alkaline phosphatase (ALP) IU/ℓ	331,3	87,6	408,9	190,6	257,2	116,2	255,0	99,0
ALT IU/ℓ	43,9	7,0	60,4	33,8	50,7	7,8	72,4	43,3
AST IU/ℓ	46,5	17,6	64,1	47,8	34,0	14,2	41,6	25,0
LDH IU/ℓ	4,5	17,6	5,0	1,4	5,6	1,6	6,0	1,8
Creatinine mmol/ℓ	168,0	26,0	163,0	25,0	156,0	27,0	161,0	61,6
Cholesterol mmol/ℓ	2,9	1,0	2,7	1,2	4,5	2,3	2,4	0,8
Ca mmol/ℓ	2,4	0,2	2,5	0,2	3,1	0,2	3,3	0,9
Mg mmol/ℓ	0,9	0,1	1,0	0,2	1,0	0,1	1,2	0,5
Phosphorus mmol/ℓ	2,8	0,5	3,0	0,5	2,4	0,4	2,5	0,5
Na mmol/ℓ	156,0	5,0	154,0	4,8	154,0	2,5	153,0	7,0
K mmol/ℓ	6,5	0,8	6,2	0,9	7,5	1,3	7,1	1,6

$\bar{x}$ = Sample mean value
SD = Sample standard deviation

trations in the skeletal and cardiac muscles, AST activities are also high in the liver, as well as other organs and tissues, including red-blood cells (Cardinet, Litterell & Freedland 1967). We observed differences in AST activities due to sex, which is contrary to what is reported in the literature on domestic species, with the exception of cows (Roussel and Stallcup 1966).

The increased ALP and AST activities in our study are also at variance with those of Odink *et al.* (1990) in a similar investigation carried out in the Netherlands. This difference may be a reflection of the degree of inflammatory processes obtained in those pigs with subclinical diseases. Also, our designation of "lesions" may be crude in that different locations, types and severities of lesions were combined into a single category.

Generally, the haematological and biochemical values obtained in this study for the healthy pigs were at some variance with similar ones in literature and this could be attributed to the fact that these are slaughterhouse pigs that have been subjected to much physical activity which has been reported to cause higher values for AST in horses, and for LDH in pigs (Cornelius 1989). However, the study revealed changes in the haematological and biochemical parameters of pigs with pathological lesions.

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