RESEARCH ARTICLE

Algerian Indigenous Dog: Hemato-Biochemical Profile in Healthy and Gastroenteritis Diseased Case

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Abstract

The purpose of this study is primarily, to establish the haemato-biochemical reference values of the indigenous canine breed in Batna area of Algeria as related to the gender effect. For this reason, 20 apparently healthy local dogs were used. A complete blood count and the serum biochemical parameters analyzed here remained mostly within the physiological reference intervals. The effect of sex was only observed in the platelet count, which is higher in female dogs, whereas the creatinine level is higher in male dogs. The second part is devoted to evaluating the haemato-biochemical parameters in dogs with moderate to severe gastroenteritis infections. A total of 37 diseased dogs were selected and classified into two groups – diseased vaccinated dogs and diseased unvaccinated dogs – to establish the haemato-biochemical parameters. Haemato-biochemical investigation shows significant alteration in diseased unvaccinated dogs than other groups.

Keyswords: Algerian indigenous dogs, Diseased, Gastroenteritis, Haemato-biochemical profile, Reference range.

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Introduction

The Algerian indigenous dog is a breed native to Algeria, and they are popularly referred to as 'Arab or Arabia' by indigenes. They were raised mainly because of their easy adaptation to climatic and nutritional conditions. Moreover, they are considered rustic and resistant breeds.

In general, it can only be said that they are a medium-sized domestic mesocephalic dog, as no data are available for a physical description or morphometry. Furthermore, hematological and biochemical data in indigenous Algerian dogs are never documented.

However, gastroenteritis infections with multiple etiologies are frequently consulted in canine

Clinics, Most are often associated with clinical and para-clinical alterations, especially a haemato-biochemical profile.

The aim of this study was, first, to establish baseline data and study the effects of sex in clinically healthy dogs. Then, the haemato-biochemical alterations of gastroenteritis in native dogs from the Batna area in Algeria were evaluated.

Materials and Methods

Animal source

A total of 57 dogs of the local area (local Arbia dog), with ages from 2 months and 9 years old, were presented in clinics at the veterinary department of Batna university during the period from 2017–2018.

The animals were classified in two groups.

- The first group contains apparently and clinically healthy dogs (n=20, including 10 intact males and 10 intact females). These animals visited the clinic for a routine consultation (vaccination and/or deworming). They were used to determine the haemato-biochemical reference values of the local canine breed in this area.
- The second group includes clinically diseased dogs (n=37, including 10 vaccinated and 27 unvaccinated dogs).

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Clinical and para-clinical examination (Coproscopic and CPV kit antigen test) were performed before the samples were taken. For the determination of reference values from healthy dogs, the samples were taken after fasting. In case of diseased dogs, samples were taken before treatment.

Hematological analysis

From the antibrachii cephalic vein of the dogs, 3 mL of blood were collected in tubes containing ethylenediaminetetraacetic acid (EDTA) as an anticoagulant. Immediately after collection, plasma was separated with a centrifuging at 3000 rpm for 10 minutes (Shyma and Vijayakumar, 2011).

Total erythrocyte cell (TEC), haemoglobin concentration (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), total leukocyte cells (TLC), and different numbers of leukocytes were determined using standard methods (Benjamin, 1985). The analysis was performed using an automatic hematology analyzer.

Biochemical analysis

For serum separation, 5mL of blood were collected in a simple test tube (Shyma and Vijayakumar, 2011) for the determination of some biochemical parameters. The concentrations of biochemical parameters (glucose, cholesterol, triglycerides (TG), total protein (TP), albumin, blood urea nitrogen (BUN), and creatinine), enzyme activity (ALT-alanine aminotransferase and AST-aspartate), and mineral parameters (calcium, inorganic phosphorus, sodium, potassium, and chloride) were determined by standard methods, using the commercial kits 'Spinreact' from Spain.

Statistical study

The data obtained were statistically evaluated by the Student's test using the Statgraphics Centurion software, version 18.1.10. The results are expressed as mean and standard deviation (X ± SD).

Results and discussion

The values of the means, SDs, and the results of the statistical analysis of the blood hematological and biochemical parameters analyzed are listed in Table 1–5. The data of clinical parameters and signs in healthy and diseased dogs are presented in Table 3.

Hematology values in healthy dogs

The mean values of the hematological parameters of the local canine breed obtained in this study are included in the range of standards presented by literature, as shown in Table 1.

The influence of sex on haemogram variation in the Algerian indigenous dogs showed no significant differences ($p > 0.05$) between male and female dogs. This finding agreed with the results from previous studies (Dash *et al.*, 2017; Atata *et al.*, 2018).

As shown in Table 1, TLC and neutrophils demonstrated the same pattern of distribution in both the sexes, while basophil variations were not observed at all. Both Hb and PCV were insignificantly lower in male dogs (12.79 ± 0.58 vs 14.17 ± 0.25 % for Hb and 38.37 ± 1.14% vs 40.54 ± 1.07 for PCV) than female dogs, respectively. This finding reported by Dash *et al.*, (2013), suggests there is no sexual dimorphism in the erythrocyte parameters (Adebiyi *et al.*, 2014).

In the current study, a slighter significant increase ($p<0.05$) in platelet counts was found in indigenous female dogs in Algeria; it aligns with reported findings of Mohammed *et al.*, (2017). It may be attributed to the hormonal profile (Bain, 1985).

Biochemistry values in healthy dogs

The mean values of the serum biochemical parameters in the indigenous dogs are obtained in the range of the physiological norms presented in Table 2. This result implies that the dogs sampled had normal energy, protein, and mineral metabolism and electrolytic balance with no renal or hepatic impairment.

A comparison of the values of the serum biochemical parameters in males and females revealed a significant and slightly higher concentration of creatinine in male dogs than females (1.32 ± 0.07 vs. 0.86 ± 0.09 mg/dl; $p<0.01$). The same finding was observed by (Chang *et al.*, 2016). This increase reflects the larger muscle size and volume of male dogs. It can also be explained by variation in the tested animal's ages, body weights, or physical activity. The results in this study, however, disagree with the findings of (Ariyibi *et al.*, 2002; Dash *et al.*, 2013) in Alsatian, Spitz, and Labrador breeds respectively, wherein female dogs had a higher creatinine level than male dogs.

Insignificant differences ($p > 0.05$) were observed between the rest of the determined biochemical values in

Table 1: Haematological values in local breed dogs, with gender effect (Mean ± SD).

		Dogs			*References values*
Parameters	*All over dogs (n=20)*	*Males (n=10)*	*Females (n=10)*	*Signification*	*Meyer and Harvey (2004) (*): Dulman et al., (2015)*
TEC (x 10^6/l)	5.90 ± 0.21	5.83 ± 0.14	5.98 ± 0.29	NS	5.4 – 7.8
Hb (g/dl)	13.48 ± 0.41	12.79 ± 0.58	14.17 ± 0.25	NS	13 – 19; 12 – 18 (*)
PCV (%)	39.45 ± 1.10	38.37 ± 1.14	40.54 ± 1.07	NS	37 – 55 (*)
MCV (fl)	70.66 ± 1.81	70.22 ± 2.06	71.10 ± 1.56	NS	64 – 74; 65 –80 (*)
MCH (pg)	24.05 ± 1.45	24.70 ± 1.21	23.40 ± 1.60	NS	22 – 27
MCHC (%)	34.74 ± 0.22	34.90 ± 0.10	34.58 ± 0.34	NS	34 – 36
TLC (x 10^9/l)	11.39 ± 1.01	11.64 ± 1.20	11.14 ± 0.83	NS	6 – 17
Neutrophils (x 10^9/l)	8.23 ± 1.47	8.50 ± 1.55	8.07 ± 1.40	NS	6 – 17 (*)
Eosinophils (x 10^9/l)	0.35 ± 0.21	0.36 ± 0.23	0.20	NS	– 1.25
Basophils (x 10^9/l)	0.00 ± 0.00	0.00 ± 0.01	0.01 ± 0.00	NS	Rare
Lymphocytes (x 10^9/l)	2.22 ± 0.67	2.20 ± 0.64	2.24 ± 0.71	NS	1.2 –3.2 (*)
Monocytes (x 10^9/l)	0.50 ± 0.06	0.51 ± 0.05	0.49 ± 0.07	NS	0.15 – 1.35 (*)
Platelet (x 10^9/l)	265.29 ± 60.21	252.38 ± 54.22	278.21 ± 66.20	a	160 – 430

NS: no significant difference ($p > 0.05$); **a**: significant at 5% level ($p<0.05$).
TEC: total erythrocytes cell, **Hb**: haemoglobin concentration, **PCV**: packed cell volume, **MCV**: mean cell volume, **MCH**: mean cell haemoglobin, **MCHC**: mean cell haemoglobin concentration, **TLC**: total leukocytes cell.

Table 2: Biochemical values in local breed dogs, with gender effect (Mean ± SD).

Parameters	All over dogs *(n = 20)*	*Dogs* *Male (n = 10)*	*Female (n = 10)*	*Signification*	*References values Kaneko et al., (2008) (*) Dulman et al., (2015)*
Glucose (mg/dL)	109.43 ± 1.11	110.12 ± 1.09	108.75 ± 1.13	NS	60–125 (*)
Cholesterol (mg/dL)	136.92 ± 4.25	136.20 ±4.31	137.64 ± 4.20	NS	116–254
TG (mg/dL)	103.90 ± 5.80	104.26 ± 5.27	103.54 ± 6.34	NS	20–112
TP (g/dL)	6.35 ± 0.12	6.41 ± 0.13	6.29 ± 0.11	NS	5.4–7.1 ; 5.5 –7.5 (*)
Albumin (g/dL)	2.89 ± 0.17	2.95 ± 0.20	2.83 ± 0.14	NS	2.6–3.3
BUN (mg/dL)	26.93 ± 1.07	27.00 ± 1.02	26.87 ± 1.12	NS	21–60
Creatinine (mg/dL)	1.09 ± 0.08	1.32 ± 0.07	0.86 ± 0.09	**b**	0.5–1.5
AST (IU/L)	27.01 ± 1.63	27.14 ± 2.18	26.89 ± 2.09	NS	0.0–66; 8.9–49 (*)
ALT (IU/L)	43.17 ± 2.65	43.50 ± 2.61	42.84 ± 2.70	NS	– 102.0; 8.2–57 (*)
Calcium (mg/dL)	10.25 ± 1.10	10.42 ± 1.11	10.11 ± 1.08	NS	8.7–11.8 (*)
Phosphorus (mg/dL)	5.06 ± 0.99	5.02 ± 1.04	5.10 ± 0.94	NS	2.6–6.2
Sodium (mmol/l)	149.03 ± 0.98	144.97 ± 0.96	145.10 ± 1.00	NS	141.0–152.0 (*)
Potassium (mmol/l)	5.05 ± 0.29	5.21 ± 0.25	4.89 ± 0.33	NS	4.4–5.3 (*)
Chloride (mmol/l)	109.88 ± 1.76	110.15 ± 1.76	109 ± 1.69	NS	105–115 (*)

NS: No significant differences (p > 0.05); **b**: Significant at 1% level (P<0.01).
TG: Triglycerides; **TP**: Total protein; **BUN:** Blood urea nitrogen; **AST**: aspartate aminotransferase; **ALT**: Alanine aminotransferase.

Table 3: Clinical parameters and signs in healthy and diseased dogs

Parameters and signs		*Healthy dogs (n = 20)*	*Diseased dogs (n = 37)*	*Diseased vaccinated dogs (n = 10)*	*Diseased unvaccinated dogs (n = 27)*
HR (beat/ min)		87.00 ± 2.25 (60–140)(*)	102.50 ± 1.55 b	95.00 ± 1.30	110.50 ± 1.80 a
RR (breath/ min)		25.50 ± 0.70 (10–35)(*)	40.00 ± 0.62 b	37.00 ± 0.50	43. 00 ± 0.75 a
RT (°C)		37.80 ± 0.27 (38–38.5)(*)	40.10 ± 0.35b	39.80 ± 0.20	40.40 ± 0.50a
Anorexia		-	28/37 (75.67%)	6/10 (60%)	22/27 (81.48%)
Diarrhea	Haemorrhagic	-	20/37 (54.05%)	4/10 (40%)	16/27 (59.25%)
	Non-haemorrhagic	-	17/37 (45.94%)	6/10 (60%)	11/27 (40.74%)
Vomiting	Haemorrhagic	-	14/37 (37.83%)	0/10 (00%)	14/27 (51.85%)
	Non-hemorrhagic	-	15/37 (40.54%)	5/10 (50%)	10/27 (37.03%)
Dehydration	Nil	-	3/37 (8.10%)	0/10 (00%)	3/27 (11.11%)
	Moderate	-	10/37 (27.02%)	1/10 (10%)	9/27 (33.33%)
	Marked	-	17/37 (45.94%)	2/10 (20%)	15/27 (55.55%)
Othersclinicalsigns		-	11/37 (29.72%)	3/10 (30%)	9/27 (33.33%)
CPV rapid antigen detection tests		-	17/37 (45.94%)	2/10 (20%)	15/27 (55.55%)

HR: heart rate, **RR**: respiratory rate, **RT**: rectal temperature. (*): a physiological range of values. **a**: significant at 5% level (p < 0.05); **b:** significant at 1% level (p<0.01).

Table 4: Haematological values variations in diseased dogs with gastroenteritis infection (Mean ± SD)

	Dogs			*Signification*		
Parameters	*Diseased unvaccinated (n = 27)*	*Diseased vaccinated (n = 10)*	*Healthy group (n= 20)*	*A*	*B*	*C*
TEC (x 10^6/l)	4.74 ± 0.36	5.01 ± 0.24	5.90 ± 0.21	a	b	NS
Hb (g/dl)	10.79 ± 0.81	12.51 ± 0.32	13.48 ± 0.41	a	b	NS
PCV (%)	33.37 ± 1.14	35.54 ± 0.97	39.45 ± 1.10	a	c	NS
MCV(fl)	62.33 ± 1.22	68.80 ± 0.48	70.66 ± 1.81	a	b	NS
MCH (pg)	19.68 ± 1.02	21.4 ± 0.53	24.05 ± 1.45	a	b	NS
MCHC (%)	29.90 ± 1.10	31.86 ± 1.64	34.74 ± 0.22	a	b	NS
TLC (x 10^9/l)	6.24 ± 0.83	12.68 ± 1.20	11.39 ± 1.01	c	c	a
Neutrophils (x 10^9/l)	4.56 ± 1.11	9.89 ± 0.71	8.23 ± 1.47	c	c	a
Eosinophils (x 10^9/l)	0.31 ± 0.19	0.34 ± 0.21	0.35 ± 0.20	NS	NS	NS
Basophils (x 10^9/l)	0.02 ± 0.00	0.01 ± 0.01	0.00 ± 0.00	NS	NS	NS
Lymphocytes (x 10^9/l)	0.86 ± 0.08	1.96 ± 0.14	2.22 ± 0.67	b	c	NS
Monocytes (x 10^9/l)	0.49 ± 0.07	0.48 ± 0.03	0.50 ± 0.06	NS	NS	NS
Platelet (x 10^9/l)	142.38 ± 36.18	213.20 ± 43.61	265.29 ± 60.21	c	c	NS

A: diseased unvaccinated vs. diseased vaccinated dogs; **B**: diseased unvaccinated vs dogs healthy dogs; **C:** diseased vaccinated dogs vs. healthy dogs.
NS: no significant differences ($p > 0.05$); **a**: significant at 5% level ($p < 0.05$); **b:** significant at 1% level ($p<0.01$); **c:** significant at 1‰ level ($p < 0.001$).
TEC: total erythrocytes cell, **Hb**: hemoglobin concentration, **PCV**: packed cell volume, **MCV**: mean cell volume, **MCH**: mean cell hemoglobin, **MCHC**: mean cell hemoglobin concentration, **TLC**: total leukocytes cell.

Table 5: Biochemical values variations in diseased dogs with gastroenteritis infection (Mean ±SD)

	Dogs			*Signification*		
Parameters	*Diseased unvaccinated (n = 27)*	*Diseased Vaccinated (n = 10)*	*Healthy group (n = 20)*	*A*	*B*	*C*
Glucose (mg/dl)	78.75 ± 1.50	114.15 ± 1.09	109.43 ± 1.11	c	c	NS
Cholesterol (mg/dl)	134.64 ± 4.41	139.23 ± 2.66	136.92 ± 4.25	NS	NS	NS
TG (mg/dl)	123.64 ± 2.40	107.50 ± 3.11	103.90 ± 5.80	a	a	NS
TP (g/dl)	5.24 ± 0.31	6.89 ± 0.28	6.35 ± 0.12	b	a	a
Albumin (g/dl)	2.30 ± 0.17	3.15 ± 0.20	2.89 ± 0.17	b	a	a
BUN (mg/dl)	39.28 ± 3.65	30.79 ± 1.83	26.93 ± 1.07	b	c	a
Creatinine (mg/dl)	1.67 ± 0.07	1.32 ± 0.04	1.09 ± 0.08	a	b	a
AST (IU/L)	33.82 ± 2.41	29.43 ± 1.85	27.01 ± 1.63	a	b	NS
ALT (IU/L)	50.66 ± 1.75	45.50 ± 2.13	43.17 ± 2.65	a	b	NS
Calcium (mg/dl)	8.42 ± 2.26	9.86 ± 2.43	10.25 ± 1.10	a	b	NS
Phosphorus (mg/dl)	4.10 ± 1.43	4.81 ± 0.74	5.06 ± 0.99	NS	a	NS
Sodium (mmol/l)	142.40 ± 1.82	146.14 ± 2.35	149.03 ± 0.98	NS	a	NS
Potassium (mmol/l)	3.53 ± 0.42	4.72 ± 0.35	5.05 ± 0.29	a	b	NS
Chloride (mmol/l)	89.54 ± 3.91	98.76 ± 1.85	109.88 ± 1.76	a	b	a

A: diseased unvaccinated vs. diseased vaccinated dogs;
B: diseased unvaccinated vs. dogs healthy dogs;
C: diseased vaccinated dogs vs. healthy dogs.
NS: no significant differences ($p> 0.05$); **a**: Significant at 5% level ($P<0.05$); **b:** Significant at 1% level ($P<0.01$); **c:** Significant at 1‰ level ($p < 0.001$).
TG: Triglycerides; **TP**: Total protein; **BUN:** Blood urea nitrogen; **AST**: aspartate aminotransferase; **ALT**: Alanine aminotransferase.

male and female dogs as reported by Muhsen and Hasso (2010) in Iraq indigenous dogs, Choi *et al.* (2011) in Beagle dogs, and Atata *et al.* (2018) in Nigerian indigenous dogs. From our studies, it can reveal that the breed of dog does not significantly affect the hematological and biochemical parameters of clinically healthy dogs.

Clinical manifestation in diseased dogs

The clinical findings in Table 3 show a higher and significant variation of heart and respiratory rates and rectal temperature in diseased dogs compared to healthy dogs ($P < 0.01$). In the diseased group, hemorrhagic diarrhea was noted in 54.05% of cases, while non-hemorrhagic diarrhea was seen only in

45.94%. However, the opposite was observed for vomiting (37.83% for hemorrhagic vomiting vs. 40.54% for non-hemorrhagic vomiting). However, most dogs were anorexic (75.67%) and dehydrated (72.97%).

In the same group, diseased vaccinated dogs had a slight decrease in clinical parameters ($P<0.05$) and moderated clinical manifestation than unvaccinated dogs (Table 3).

These clinical manifestations are related to the gastroenteritis infection, which is a term used to describe a syndrome characterized by the sudden onset of vomiting and/or diarrh ea caused by inflammation of the gastrointestinal mucosa, thus causing the onset anorexia, fever, and weight loss. Furthermore, fluid and blood losses stimulate cardio-respiratory adapter mechanisms via catecholamine and cause compensatory tachycardia and tachypnoea (Greene and Decaro, 2012). However, variations in the clinical signs in different dogs may be due to individual host resistance, the virulence of the causative agent, and nutritional status of the individual dog (Banja *et al*., 2002).

According to the paraclinical exam, neither gastrointestinal parasites nor protozoa were found in any of the dogs studied. In 17 cases (45.94 %), the cause of gastroenteritis was parvoviral as canine parvoviral antigen (CPV–2) was detected. The causative agent of enteritis or gastroenteritis in the remaining 20 dogs could not be determined in this study (Table 3).

Hematology variation in diseased dogs

For the hematology data, diseased unvaccinated dogs had significantly lower levels ($p < 0.05$, $p < 0.01$, $p < 0.001$) in erythrogram (TEC, Hb, PVC, MCV, MCH, MCHC), leukogram (neutrophil, lymphocyte), and platelet count compared with diseased vaccinated and healthy dogs (Table 4). These results were in accordance with Abd El-Baky*et al*., (2017). A non-significant change in eosinophils, basophils, and monocytes counts were noted in this study was confirmed by other research (Ramprabhu *et al*., 2002).

According to the paraclinical data revealed in our study, the quasi-totalities of the diseased unvaccinated dogs were CPV positive. Thus, in this case, the microcytic hypochromic anemia, leucopenia due to neutropenia and/or lymphopenia, and thrombocytopenia are the result of the direct effect of parvovirus on bone marrow, leading to a decrease of the cell lines production (granulocytes, erythroid, and megakaryocytes) (Terzungwe, 2018).

A haemogram did not show statistically significant differences between the diseased vaccinated dogs and healthy group, which is probably related to non-bleeding clinical manifestations. However, the leukocyte and neutrophil values of the latter were significantly higher than the control and diseased unvaccinated dogs. This finding may be due to the general reaction of the immune system to bacterial infection and inflammatory processes in GIT. In fact, interleukin-1 stimulates neutrophilia and results in the adherence of leukocytes (Bhat *et al*., 2013).

Biochemical variations in diseased dogs

The statistical analysis of the biochemical parameters by the *t*-test between healthy and diseased dogs are presented in Table 5 above.

Compared with healthy dogs and diseased vaccinated dogs, diseased unvaccinated dogs had significantly lower concentrations of glucose, TP, albumin, calcium, sodium, potassium, and chloride. These data are related to those of Mylonakis *et al.* (2016). They also had significantly increased concentrations of BUN and creatinine but a slighter increase of serum activities of AST and ALT (Table 5) as reported by (Bhat *et al*., 2013). A significant increase of triglyceride was noted in diseased unvaccinated dogs rather than other groups; the same result was reported by Salem *et al*., (2018).

In gastroenteritis infection, hypoglycaemia resulting in an interaction between severe malnutrition may be due to inappetence/anorexia complemented by malabsorption from the intestine (Bhat *et al*., 2013). The hypertriglyceridemia was attributed to modifications in lipid metabolism and acute phase response (Yilmaz and Senturk, 2007).

However, the damage of intestinal villi by the effect of a causative agent might cause a condition of protein-losing enteropathy. Also, the generation of acute-phase proteins as a reaction to inflammation and tissue impairment comes with the expanse of albumin synthesis. Increased BUN reflects pre-renal uremia, probably due to the reduced rate of renal glomerular filtration because of haemo-concentration and the catabolic breakdown of tissues as a result of fever. Moreover, dehydration as a consequence of vomiting and diarrhea might be linked to BUN elevation and creatinine concentration, as reported by (Atata, 2017). However, the elevation in serum activities AST and ALT may occur as hepatic hypoxia secondary to severe hypovolemia or the absorption of toxic substances due to the loss of the intestinal barrier (Shah *et al*., 2013).

According to our data, the unbalanced electrolytes revealed in gastroenteritis infections could be due to a loss of potassium in the diarrheal fluid as well as to sodium and bicarbonate. Additionally, the colon retains sodium but not potassium and is lost in excess, leading to hypokalaemia. Hypochloraemia may be due to a severe loss of chloride ions by vomiting and a loss of chloride ions in the secretion of intestinal fluid during diarrhea (Bhat *et al*., 2015).

For vaccinated dogs, in general, moderate to severe fluid loss by diarrhea and vomiting is expressed by some alteration of serum biochemical parameters as TP and albumin. Increased TP and albumin concentrations observed due to haemo-concentration because of dehydration. Our finding agrees with previous reports (Salem, 2014). The observed normal concentrations of blood glucose in this study agreed with the data of (Atata, 2017), proving that glucose concentrations was not adversely affected by dehydration–thus agreeing with the notion that blood glucose level is tightly regulated because of its role in maintaining the central nervous system function (Rodriguez *et al*., 2005).

Conclusion

The haemato-biochemical values obtained from this study can serve as reference data in differentiating the healthy and diseased animals in local climatic conditions and support the proper clinical-pathological diagnosis of diseases in dogs raised in the Batna area, Algeria. Further work should be done to investigate the effect of age, reproductive stage, diet, and physical activity of the animals on the different blood haemato-biochemical profile.

Severe changes in complete blood count and serum biochemical profile have been reported in unvaccinated diseased dogs with gastroenteritis infection. These profiles can easily be used as paraclinical indicators to differentiate healthy from diseased animals. Alternatively, diseased vaccinated dogs had moderate clinical manifestation and a high rate of cure. Thus, we need to popularise and recommend vaccinating the local dog population in the Batna area to protect the animals better.

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