Science et technique

Revue burkinabè de la recherche

Sciences naturelles et appliquées

Spécial hors-série n° 6 — Janvier 2022 — ISSN 1011-6028

Symposium International sur la Science et la Technologie
15 au 19 novembre 2021, Ouagadougou

Numéro spécial
19 articles

Centre national de la recherche scientifique et technologique
03 B.P. 7047 Ouagadougou 03 – Burkina Faso

Science **et** technique

Revue burkinabè de la recherche

Sciences naturelles et appliquées

Spécial hors-série n° 6 — Janvier 2022 — ISSN 1011- 6028

Symposium International sur la Science et la Technologie
15 au 19 novembre 2021, Ouagadougou

Centre national de la recherche scientifique et technologique
03 B.P. 7047 Ouagadougou 03, Burkina Faso

Science et technique

Revue semestrielle de la recherche
du **Centre National de la Recherche Scientifique et Technologique (CNRST)**

Série Sciences Naturelles et Appliquées

Spécial hors-série n° 6 – Janvier 2022

Prix : 3 000 F CFA

Directeur de publication
DRABO Koiné Maxime, Délégué général du CNRST

Directeurs adjoints de publication
Hamidou TRAORE
Emmanuel NANEMA

Comité de publication
- ***Président :*** Adama KABORE
- ***Editeur scientifique :*** Noufou OUEDRAOGO
- ***Maquette et mise en forme :*** Elie ZABRE
- ***Secrétaire de rédaction :*** Moustapha KABORE

Comité de rédaction
- ***Coordonnateurs :*** Hadja Oumou SANON
  Charles PARKOUDA
- ***Rédacteurs en Chef*** **:** Djibril YONLI
  Serges IGO
- ***Rédacteurs en Chef adjoints :*** Mariam Myriam DAMA
  Rayim Wendé Alice NARE

20.	HALPOUGDOU Martial	Chargé de recherche	Histoire
21.	HOUNHOUIGAN Djidjoho Joseph	Professeur Titulaire	sciences et technologie des aliments
22.	IGO Serge	Directeur de recherche	Physique / Thermique
23.	KABORE Adama	Directeur de Recherche	Biologie et Santé animales
24.	KABORE Oumar	Maître de recherche	Géographie physique
25.	KABORE/SAWADOGO Séraphine	Chargée de recherche	Télédétection
26.	KIBORA Ludovic	Maître de recherche	Anthropologie, Ethnologie
27.	KINI Félix	Directeur de recherche	Chimie organique
28.	KOSSI-TITRIKOU Komi	Professeur Titulaire	Anthropologie
29.	KOUANDA Séni	Directeur de recherche	Epidémiologie, Santé Publique
30.	KOUHOUNDE Serge	Assistant	Biotechnologie/Microbiologie Alimentaire
31.	KOULIDIATI Jean	Professeur Titulaire	Physique
32.	LOMPO Marius	Directeur de recherche	Pharmacologie
33.	MAKAYA Joseph	Maître-Assistant	Biochimie/ Microbiologie
34.	METCHEBON TAKOUGANG Stéphane Aimé	Maître de conférences	Mathématiques appliquées
35.	NAKOULMA Goama	Maître de recherche	Géographie
36.	NANEMA Emmanuel	Directeur de Recherche	Energie solaire
37.	NEBIE Roger Ch. H.	Directeur de Recherche	Chimie organique
38.	NEYA Bouma James	Maître de recherche	Phytopathologie
39	NEYA Oblé	Maître de Recherche	Biologie et physiologie végétales
40.	NIANGADO Oumar	Directeur de Recherche	Génétique
41.	OUEDRAOGO Idrissa	Professeur Titulaire	Economie
42.	OUEDRAOGO Jean Bosco	Directeur de Recherche	Parasitologie médicale
43.	OUEDRAOGO Mahamadou Lamine	Maître de conférences	Sciences du langage
44.	OUEDRAOGO Mahamoudou	Assistant	Communication
45.	OUEDRAOGO Moussa	Docteur	Génétique Forestière
46.	OUEDRAOGO Noufou	Directeur de recherche	Biochimie/Pharmacologie
47.	OUEDRAOGO Souleymane	Maître de recherche	Economie agricole
48.	OUEDRAOGO Sylvin	Directeur de recherche	Pharmacologie
49.	OUOBA Youmanli	Maître de conférences agrégé	Economie de l'environnement
50.	SANKARA Philippe	Professeur Titulaire	Phytopatologie
51	SANOGO Mamadou Lamine	Directeur de recherche	Socio-linguistique
52	SANOGO Oumar	Directeur de Recherche	Physique
53	SANON Hadja Oumou	Maître de Recherche	Productions animales
54	SAWADOGO Louis	Directeur de recherche	Biologie et Ecologie végétale
55	SAWADOGO/LINGANI Hagrétou	Directrice de recherche	Biochimie-Microbiologie/Technologie Alimentaire
56	SEDOGO P. Michel	Directeur de Recherche	Agropédologie
57	SEMDE Rasmané	Professeur Titulaire	Pharmacie galénique
58	SEREME Drissa	Maître de Recherche	Virologie
59	SEREME Paco	Directeur de Recherche	Phytopathologie
60	SIE Oumarou	Professeur Titulaire	Informatique
61	SIRPE Gnanderman	Maitre de conférences	Economie
62	SOMDA Irénée	Professeur Titulaire	Phytopathologie
63	TINTO Halidou	Directeur de recherche	Parasitologie
64	TRAORE Alfred	Professeur Titulaire	Biochimie
65	TRAORE Hamidou	Directeur de Recherche	Malherbologie
66	TRAORE Mamoudou	Maître de recherche	Sciences du sol
67	YAMBA Kassoum	Chargé de Recherche	Physique appliquée
68	YAMEOGO Georges	Maître de recherche	Agroforesterie
69	YAMEOGO Urbain	Assistant	Environnement
70	YE Georges Siédouba	Maître de recherche	Mécanique Appliquée/ Machinisme Agricole
71	YONLI Djibril	Maître de recherche	Malherbologie
72	ZEBA Augustin	Chargé de recherche	Nutrition
73	ZERBO Roger	Maître de recherche	Sociologie, Anthropologie de la santé
74	ZIDA Didier	Maître de Recherche	Ecologie /Aménagement forestier
75	ZIDA Elisabeth	Maître de recherche	Phytopathologie
76	ZOUGMORE Robert Bellarmin	Directeur de recherche	Science du sol

Abonnement - Distribution
DIST/DGA-V/CNRST, 03 B.P. 7047 Ouagadougou 03

Rédaction et administration
- Comité de rédaction, INERA 03 B.P. 8645 Ouagadougou 03 Burkina Faso ; Tél : (00226) 25 34 02 70/ 25 34 71 12 ; Fax : (226) 25 34 02 71 ; Email : inera.direction@fasonet.bf
- Comité de rédaction, IRSAT 03 B.P. 7047 Ouagadougou 03 Burkina Faso ; Tél : (226) 25 35 60 31 ; Fax : (226) 25 35 70 29 ; Email : dirsat@fasonet.bf ; Site web : www.irsat-burkina-net

Impression : Presses Universitaires – Université Joseph Ki-Zerbo - Ouagadougou

Numéro tiré à 100 exemplaires

Sommaire

Comparative study of the effect antibiotics and feed ingredient containing probiotic bacteria from "*Tchoukoutou*" ferment on the immune status of local and exotic guinea fowl

Jean GLAGO[1*], Comlan Kintomagnimessè Célestin TCHEKESSI[2], Cocou Claude KPOMASSE[3], Nicodème Worou CHABI[4], Amivi Kafu TETE-BENISSAN[5], Makpondji Frédéric HOUNDONOUGBO[6], Jacob Kokou TONA[7,4] , Christophe Achille Armand Mahussi CHRYSOSTOME[8]

Résumé

L'antibiorésistance est un réel problème de santé publique lié à l'utilisation d'antibiotiques dans la production d'animaux de consommation. La présente étude vise à comparer l'effet de l'ingrédient alimentaire contenant des bactéries probiotiques du ferment de « *Tchoukoutou* » et d'antibiotiques (alfacéryl) sur l'état immunitaire de pintades locales et exotiques (*Numida meleagris*). Les oiseaux de chaque souche étaient répartis en trois traitements expérimentaux : traitement R_1 a reçu une ration alimentaire contenant 3 % de l'ingrédient tandis que traitements R_2 et R_3 étaient nourris avec un aliment standard. En outre, traitement R_3 était traité avec alfacéryl. A la sixième semaine, des échantillons de sang étaient prélevés sur 75 pintades de chaque souche pour l'étude des paramètres biochimiques et hématologiques. Indépendamment des souches, il y avait des différences significatives ($p < 0,05$) dans les valeurs de protéines totales, globules rouges et blancs, hémoglobine, hématocrite, volume globulaire moyen et concentration globulaire moyenne en hémoglobine. Cela a prouvé que l'ingrédient expérimental améliorait les performances sanitaires de ces oiseaux et les faibles proportions voire l'absence des polynucléaires révélés par l'hémogramme ont montré que ces animaux étaient à l'abri de toutes infections. **Conclusion :** l'ingrédient a le même effet qu'alfacéryl sur l'état immunitaire de ces pintades.

Mots clés : probiotiques, antibiotiques, pintades, paramètres biochimiques et hématologiques.

[1] Regional Center of Excellence on Poultry Sciences (CERSA), Univesrity of Lome, Republic of Togo. Tel: (+228) 79435367, 01 BP: 1515 Lomé, E-Mail: johnjimonfafglago@gmail.com

[2] Food Health Safety Research Unit (URSSA), Laboratory of Microbiology and Food Technology (LA.MI.T.A), Department of Plant Biology, Faculty of Sciences and Technologies (FAST) of Abomey-Calavi University (UAC), 04BP 888 Cotonou, Benin ; Tel. : (+229) 97810040, E-mail : tchecokice@yahoo.fr

[3] Regional Center of Excellence on Poultry Sciences (CERSA), Univesrity of Lome, Republic of Togo. Tel: (+228) 98319004, 01 BP: 1515 Lomé, E-mail: claudez1984@yahoo.fr

[4] Unit of Biochemistry and Molecular Markers in Nutrition, Laboratory of Research in Applied Biology, Polytechnic School of Abomoey-Calavi, University of Abomey-Calavi, Godomey, Benin, Box: 955 Abomey-Calavi, Benin. Tel: +229 97 08 49 06, Email: nicodeme.chabi@gmail.com

[5] Regional Center of Excellence on Poultry Sciences (CERSA), Univesrity of Lome, Republic of Togo. Tel: (+228) 90 03 84 02, 01 BP: 1515 Lomé, E-mail: colette.gassou@gmail.com

[6] Poultry Research Laboratory and Zoo-Economics, Faculty of Agricultural Sciences, University of Abomey-Calavi, Benin. Tel : (+229) 95 96 81 36, 01 BP: 526 Cotonou, E-mail: fredericmh@gmail.com

[7] Regional Center of Excellence on Poultry Sciences (CERSA), Univesrity of Lome, Republic of Togo. Tel: (+228) 90 20 16 46, 01 BP: 1515 Lomé, E-mail : jaktona@gmail.com

[8] Poultry Research Laboratory and Zoo-Economics, Faculty of Agricultural Sciences, University of Abomey-Calavi, Benin. Tel: (00229) 95585142, 01 BP: 526 Cotonou, E-mail : larazefsauac@gmail.com

[*]**Corresponding author:** E-mail: johnjimonfafglago@gmail.com, Tel: (00228) 79435367 / (00229) 95659163

Abstract

Antibiotic resistance is a real public health problem related to the use of antibiotics in the production of animals feed. The present study aims to compare the effect of feed ingredient containing probiotic bacteria from "*Tchoukoutou"* ferment and antibiotics (alfaceryl) on the immune status of local and exotic guinea fowl (*Numida meleagris*). The birds of each strain were divided into three experimental treatments: treatment R_1 received a feed ration containing 3% of this experimental ingredient while treatments R_2 and R_3 were fed a standard feed with R_3 receiving alfaceryl. At the sixth week, blood samples were taken from 75 guinea fowl of each strain for the study of biochemical and hematological parameters. Regardless of the strain, there were notable the significant differences ($p<0.05$) in the values of total protein, red and white blood cells, hemoglobin, hematocrit, mean corpuscular volume and mean corpuscular hemoglobin concentration. This proved that the experimental ingredient improved health performance in these birds and the low proportions or even the absence of polynuclear cells revealed by the blood count showed that these animals were free from all infections.
Conclusion: The ingredient has the same effect as alfaceryl on the immune status of these guinea fowl strains.

Key words: probiotics, antibiotics, guinea fowl, biochemical and hematological parameters.

Introduction

Animal and human welfare are closely correlated to the limitation of routes of transmission of antimicrobial resistance from bacteria to animals via the food chain. This may pose a public health problem (KAUKAS, 1988). Indeed, the intensification of animal production in recent decades resulted in the use of veterinary drugs, in particular antibiotics (GIGUERE *et al.*, 2013). They have probably been used successfully to improve the immune status of farm animals in many parts of the world (CLOUTIER *et al.,* 2015). In livestock, antibiotics are generally used for prophylaxis (preventive treatment), therapy (curative treatment) and metaphylaxis (control treatment) or as a food additive for promoting growth of animal (MENSAH *et al.,* 2014). However, overuse of antibiotics has led to the development of antibiotic resistance and the accumulation of antibiotics residues in animal products (MOHARRERY and MAHZONIEH, 2005; ALLOUI, 2011; WHO, 2020). The presence of these antibiotic residues in food is a reality. This presence highlights the misuse of veterinary drugs, in particular the failure to respect the withdrawal period (ABIOLA *et al.,* 1999). Thus, whatever the nature of the antibiotic administered, the risk of finding residues in the tissues (meat) and excretion products (milk, eggs) is present. It is for this reason that a threshold has been set for each drug beyond which the amount of residues present in a feed presents a direct danger to the health of the consumer. In foods of bovine origin, the meat is contaminated at 38% and the liver at 57%. In food of avian origin, the gizzards are contaminated at 9% and the livers at 11.7% (OKOMBE *et al.,* 2016). The contamination rate is higher for the liver than for meat and gizzard (OKOMBE *et al*., 2016). Several studies have highlighted the drastic side effects of these antibiotic residues in human health. There are allergy problems and especially the development of resistant bacteria responsible for antibiotic failures both in animals and humans (ROSOL and CAPEN, 1997; CHOPRA and ROBERTS, 2001; SANDER *et al.,* 2011 and MADEC, 2014). All these reasons led to the ban on the use of antibiotics as growth promoters in animal production in January 2006 (AFSSA, 2006). Probiotics which is natural products with no side effects could serve as alternative for farmers use. In this light, probiotic bacteria from the ferment of *Tchoukoutou* was produced to be incorporated directly into diets of animals. This ingredient comprised bacterial strains such as: *Lactobacillus casei, Lactobacillus fermentum, Lactobacillus acidophilus* and *Enterococcus faecium.* Many related findings to the use of this ingredient on the immune status have been highlighted in the work of GNIKPO *et al.* (2017) who incorporated in the diets of rabbits, larvae of *Clarias gariepinus* (catfish, Clariidae) and broilers. However, very few studies have been done on local and exotic guinea fowl. Thus, the objective of this study is to compare the effect of feed ingredient containing probiotic bacteria from *Tchoukoutou* ferment and antibiotics (alfaceryl) on the immune status of local and exotic guinea fowl.

I. Materials and methods

1.1. Experimental location

The experiment was carried out at the poultry Research Laboratory and Zoo-Economy of faculty of agricultural science of University of Abomey-Calavi of Benin at the beginning of December 2020 and at the end of March 2021. It is located in tropical areas where the temperature generally varies from 24° C to 33° C and relative humidity which varies from 60% to 84% during the year.

1.2. Experimental design

Three hundred and seventy-five unsexed day-old keets of both local and exotic strains of guinea fowl were used in the study. Birds were assigned to three treatments of five replications of 25 birds each for each strain: group R_1 guinea fowl fed a diet in which 3% of the feed ingredient containing probiotic bacteria from *Tchoukoutou* ferment was incorporated and birds of R_2 and R_3 groups received standard diet (Table I). Birds of R_3 group received an antibiotic (Alfaceryl) treatment except. At six (06) weeks of age, blood samples of five birds per replication (75 blood samples per strain) were collected in plain tubes and EDTA tubes. Blood in plain tubes were immediately centrifuged and used for blood biochemical analysis. But, blood samples collected in EDTA (Ethylene Diamine Tetra-Acetic) tubes were used for hematological analyses. The biochemical parameters analyzed included total cholesterol, total proteins and calcium while the hematological ones were: red blood cells, hemoglobin, hematocrit, white blood cells, mean corpuscular volume, mean corpuscular hemoglobin concentration, average corpuscular hemoglobin level, polynuclear neutrophils, eosinophilic polynuclear cells, polynuclear basophils, monocytes, lymphocytes and platelets.

Table I: Composition of Experimental diet

Ingredients	Feed starter	Feed growth
Maze	58.3	59.4
Wheat bran	3	5
Soybean meal	30	25
Cotton cake	4	6
Palm oil	1	1
Oyster shell	1.8	1.8
Lysine	0.2	0.1
Methionine	0.2	0.2
Dicalcium phosphate	1	1
NaCl	0.3	0.3
Prémix (CMV)	0.2	0.2
Total	**100**	**100**
Nutritional composition		
Dry matter (%)	87	87
Crude protein (%)	20.22	19.17
Lysine (%)	1.19	1.02
Methionine (%)	0.5	0.5
Amino acid sulfur (%)	0.87	0.85
Calcium (%)	1	1
Phosphorus (%)	0.6	0.7
Metabolizable energy (kcal / kg)	2879	2858

1.3. Statistical analysis

Raw data for biochemical and hematological parameters were entered into Excel 2016 software, before being imported into R.4.0.2 software for statistical analyzes. In order to compare the effects of this ingredient and antibiotics on the two strains of guinea fowl with different growth metabolism, two-way ANOVA analyzes were done. Means significant at $p<0.05$ were separated using Tukey's test. All parameters analyzed were presented as mean ± standard deviation.

II. Results

2.1. Biochemical parameters

Table II presents the results of the analyzes of the biochemical parameters in local and exotic guinea fowl.

Table II: results of analyzes of biochemical parameters in local and exotic guinea fowl

Parameter variables	Local guinea fowl			Exotic guinea fowl			Normal values	Strains	Groups	Interaction
	R_1	R_2	R_3	R_1	R_2	R_3				
Total pro. (g/l)	46.50 ± 9.50	41.13 ± 4.21	36.33 ± 4.30	26.10 ± 1.12	26.01 ± 2.86	25.60 ± 2.02	60-75	0.001***	0.20	0.26
Total chol. (g/l)	1.36 ± 0.24	1.13 ± 0.25	1.40 ± 0.22	1.30 ± 0.42	1.13 ± 0.15	1.44 ± 0.17	1.5-2.5	0.96	0.19	0.95
Cal (mg/l)	85.33 ± 9.01	91.00 ± 6.24	85.66 ± 5.03	97.00 ± 6.08	91.33 ± 15.14	95.66 ± 13.65	87-105	0.14	0.99	0.58

Total chol: *total cholesterol, total pro: total proteins and Cal: calcium; groups: treatments; a, b: on the same line, the assigned values of different letters are significantly different ($p<0.05$)*

Statistical analysis of biochemical parameters in local and exotic guinea fowl revealed that total cholesterol and calcium values were all similar ($p>0.05$). On the other hand, there was a significant difference ($p<0.05$) in the level of the values of the total proteins with a tendency where these values are high in the guinea fowl of local strain unlike the exotic strain. In addition, the various values obtained from the statistical analyzes were all lower than normal.

2.2. Hematological parameters

Table III presents the results of the analyzes of the hematological parameters in local and exotic guinea fowl.

Table III: results of analyzes of hematological parameters in local and exotic guinea fowl

Parametr variables	Local guinea fowl			Exotic guinea fowl					
	R_1	R_2	R_3	R_1	R_2	R_3	Strains	Groups	Interaction
Hematology									
RBC (n/mm^3)	2.87 ± 0.14	3.05 ± 0.04	3.48 ± 0.33	2.45 ± 0.26	2.21 ± 0.09	2.26 ± 0.22	0.001***	0.13	0.02
Hb (g/dl)	14.96 ± 0.92	16.73 ± 1.95	18.30 ± 1.27	12.50 ± 2.45	11.83 ± 1.26	13.46 ± 1.10	0.001 ***	0.08	0.35
HCT (%)	39.93 ± 3.06	42.43 ± 4.99	50.46 ± 5.07	34.73 ± 6.20	31.86 ± 4.38	35.40 ± 3.27	0.005 ***	0.08	0.22
WBC (n/mm^3)	143.53 ± 10.49	149.43 ± 0.37	145.76 ± 5.55	125.40 ± 7.47	123.30 ± 5.92	120.90 ± 12.61	0.005 ***	0.80	0.66
MCV (fL)	139.50 ± 15.94	139.10 ± 15.80	144.60 ± 3.48	164.53 ± 6.03	155.40 ± 1.30	155.46 ± 2.06	0.002 **	0.69	0.46
ACHL (pg)	52.20 ± 4.68	54.83 ± 6.21	52.50 ± 1.90	58.96 ± 1.55	57.73 ± 1.79	59.03 ± 1.45	0.006 **	0.93	0.57
MCHC **(g/l)**	37.50 ± 1.21	39.43 ± 1.13	36.30 ± 1.15	35.86 ± 0.73	37.16 ± 1.35	37.96 ± 0.50	0.16	0.05	0.01
Plq (g/l)	12.00 ± 5.56	10.66 ± 3.51	9.00 ± 2.00	13.33 ± 2.30	18.66 ± 2.08	14.00 ± 3.46	0.01	0.29	0.27
Blood formulas in%									
PN	0.04 ± 0.05	0.04 ± 0.01	0.04 ± 0.01	0.05 ± 0.02	0.05 ± 0.01	0.04 ± 0.01	0.53	0.60	0.63
PE	0	0	0	0	0	0	0	0	0
PB	0	0	0	0	0	0	0	0	0
M	0.04 ± 0.05	0.03 ± 0.03	0.02 ± 0.01	0.01 ± 0.01	0.02 ± 0.05	0.02 ± 0.02	0.07	0.92	0.25
L	0.91 ± 0.01	0.91 ± 0.02	0.93 ± 0.01	0.93 ± 0.02	0.92 ± 0.01	0.93 ± 0.03	0.26	0.66	0.77

a, b: on the same line, the assigned values of different letters are significantly different ($p < 0.05$); RBC: number of red blood cells; Hb: hemoglobin; HCT*: hematocrit; WBC: number of white blood cells; MCV: mean corpuscular volume; MCHC: mean corpuscular hemoglobin concentration; ACHL: average corpuscular hemoglobin level, PN: polynuclear neutrophils; PE: eosinophilic polynuclear cells; PB: polynuclear basophils; M: monocytes; L: lymphocytes and Plq: platelets, n: number; groups: treatments.*

At the level of hematological parameters, the results obtained from statistical analyzes proved that mean corpuscular hemoglobin concentration, platelets or thrombocytes, polynuclear neutrophils, eosinophilic polynuclear cells, polynuclear basophils, monocytes and lymphocytes that there was no significant difference ($p>0.05$). However, there was a difference ($p<0.05$) with values such as red blood and white cells, hemoglobin, hematocrit, mean corpuscular volume and average corpuscular hemoglobin level.

III. Discussion

This study is to compare the effect of the feed ingredient containing probiotic bacteria from *Tchoukoutou* ferment and antibiotics (alfaceryl) on the immune status of local and exotic guinea fowl. In human and veterinary medicine, biochemical and hematological analyzes are all clinical analyzes. In fact, biochemical analyzes make it possible to check the normal or malfunctioning state of organs, including the kidney, liver and heart, while hematological analyzes make it possible to study the blood and its diseases. After statistical analyzes and regardless of the strain and the experimental treatments applied, the total protein concentration was high in the birds of group R_1 which received a feed ration in which 3% of the feed ingredient containing probiotic bacteria from *Tchoukoutou* ferment was incorporated. This increase in proteins confirmed by biochemical analysis of the plasma may be due to an improvement in nutritional status and probably to an increase in albumin seen as an improvement in the immune system. This result is similar to that of MURRAY, (2002) who showed that proteins are involved in the main functions of the organism such as maintenance of oncotic pressure, transport of fat soluble molecules, immunity, chemical messengered (insulin, adrenaline), mediators of inflammation, coagulation, buffer system and protection system against oxidative stress and others. However, regardless of strains and experimental treatments, all values of biochemical parameters were low compared to normal values. This observation can be explained by the effect of feed, age, sex, race or environment. These results are consistent with those of BATHILY *et al.* (2014) and BEN ROMDHANE *et al. (*2000) who demonstrated that the variation in the values of biochemical parameters depends on the environment and in the same vein, results found by HOCHLEITHNER, (2013), CAMPBELL, (2004) and THRALL *et al.* (2012) who showed that total protein values varied with diet in broilers. Moreover, this improvement in immune status can also be explained by the low levels of polynuclear cells and the number of white blood cells or leukocytes which were relatively constant from one strain of guinea fowl to another. These low or almost constant levels, proven by-the values of the hematological parameters, made it possible to say that these birds were free from all infections. With regards to the other hematological parameters, the values of red blood cells of the local guinea fowl were relatively low in the R_1 group unlike the control groups R_2 and R_3. However, in the exotic guinea fowl, the values were relatively high compared to the control groups. The mean corpuscular volume which accounts for the mean size of red blood cells was also relatively low in birds of groups R_1 and R_2. But in exotic guinea fowl, this mean corpuscular volume was elevated in the R_1 birds compared to the R_2 and R_3. However, the average corpuscular hemoglobin level which is the ratio between hemoglobin and hematocrit was also relatively low at the level of subjects in groups R_1 and R_2 compared to group R3 in the exotic strain. It can therefore be deduced from these results that no health threat was observed. These results were similar to those found by BELLIER and CORDONNIERB, (2010) who reported that the average corpuscular hemoglobin level, which makes it possible to make a precise diagnosis of anemia could have negative impact on cardiac activity but the mean corpuscular hemoglobin concentration was within normal limits of the species considered. Similarly, PAVIC and PATRICK, (2013) reported that the normal values of mean corpuscular hemoglobin concentration vary from 32 to 36%. When these values are less than 32%, this explains hypochromia (decrease in iron in hemoglobin). On the other hand, when these values are higher than 36%, this explains the normochromia (increase of iron in the hemoglobin). Thus, the use of this ingredient during the

production cycle of these birds led to normochromia, which is perceived as an improvement in the immune status.

These results are also similar to those of GNIKPO *et al.* (2017) when they carried out an experiment on *Clarias gariepinus* (catfish, Clariidae) larvae reared in above-ground tanks with a feed ration in which the feed ingredient with probiotic properties was incorporated at 6%. The increase in average globular volume or average corpuscular volume observed in the R_1 group in exotic guinea fowl may be linked either by its high production of erythrocytes, or by an increase in iron in red blood cells previously explained in the case of normochromia. This result is similar to that of NDOUTAMIA and GANDA, (2005) who indicated that the treatment of small ruminants (kirdimis sheep) with antibiotics (oxytetracycline) revealed the case of normochromia. During this experiment, the results obtained proved that the use of the feed ingredient containing probiotic bacteria obtained from *Tchoukoutou* ferment were similar to those obtained using an antibiotic, alfaceryl.–

Conclusion

The incorporation of 3% of the feed ingredient containing probiotic bacteria of the *Tchoukoutou* ferment in the diets of local and exotic guinea fowl improved the concentration of total proteins and mean corpuscular hemoglobin concentration and consequently normochromia. Regarding alfaceryl, no deleterious effects were observed biochemically and hematological. However, the ban on the use of antibiotics as growth promoters in the production of food animals allows this ingredient to be used as an alternative.

Acknowledgment

The authors appreciate the World Bank for funding this research project through the Regional Center of Excellence on Poultry Sciences (CERSA), Univesrity of Lome, Republic of Togo.

Bibliographical references

ABIOLA FA, BIAOU C and FAURE P., 1999. Good use of the veterinary medicinal product and drug residues in food. In: Fourth seminar on veterinary drugs in Africa, Dakar, EISMV, December 6 to 10, Paris, OIE, 125 -128.

AFSSA, 2006. Veterinary Uses of Antibiotics, Bacterial Resistance and Consequences for Human Health. Bialec Printing - Nancy Legal Deposit January 2006.

ALLOUI M. N., 2011. Phytobiotics as an alternative to growth promoting antibiotics in poultry feed. *Livestock Research for Rural Development*. Vol 23 (6): 1-3

BATHILY A., SOW A., KALANDI M. et SAWADOGO G.J., 2014.Morphobiometric and biochemical parameters of traction horses in Senegal *International Journal of Biological and Chemical Sciences,* ISSN 1997-342X.

Available online at http://ajol.info/index.php/ijbcs

BEN ROMDHANE S., ROMDANE M. N., MHIRI S., Ben Miled M.A., and M. KORTAS M., 2000. Biochemical and hematological parameters in the ostrich (Struthio-camelus) in a Tunisian breeding. *Veterinary Medicine* 151, 3, 231-238.

BELLIER S. and CORDONNIERB N., 2010. Usual values in veterinary hematology. *French-language laboratory review* - n ° 420

CAMPBELL, D., 2004. "Cultural Governance and Pictorial Resistance: *Reflections on the Imaging of War" Review of International Studies* 29, pp. 57-73.

CHOPRA I. and ROBERTS M., 2001. Tetracycline Antibiotics: Mode of Action, Applications, Molecular Biology, and Epidemiology of Bacterial Resistance. *Microbiology and Molecular Biology Reviews* 65: 232-260.

CLOUTIER L. & KLOPFENSTEIN C., 2015. Food additives having effects on health or on growth performance in pigs and poultry. *Quebec Pork Development Center* 1-39.

GIGUÈRE S, PRESCOTT JF. and DOWLING PM., 2013. Antimicrobial therapy in veterinary medicine. *Wiley Blackwell (Editor), 5th Edition, Ames, Iowa, USA*. 675 pp.

GNIKPO A.F., CHRYSOSTOME C.A.A.M., HOUNDONOUGBO F.M., ADENILE A.D., DOUGNON T.J., and CODJIA J.T.C., 2017. Effectiveness of probiotic feed ingredient on the growth performance of broiler. *International Journal of Biological and Chemical Sciences,* 10 (3): 1163-1172.

HOCHLEITHNER, M., HRUBEC, T.C., WHICHARD, J.M., LARSEN, C.T. RITCHIE B. W., HARRISON G. J., & HARRISON L. R., 20013. Biochemistries. Avian Medicine: *Principles and Application*, pp. 223-245

KAUKAS A., 1988, The effect of growth-promoting antibiotics on the *faecal enterococci* of healthy young chickens. *Journal of Applied Bacteriology*, 64, 57-64

MADEC JY., 2014. The challenges associated with antibiotics used in animal husbandry. The New Practitioner. Veterinarian, *livestock and health*, 7 (26): 13-17.

MENSAH SEP, LAURENTIE M, SALIFOU S, SANDERS P, MENSAH GA, ABIOLA FA. and KOUDANDÉ OD., 2014. Use of antibiotics by farmers in the Center of **Benin, what are the risks for public health? Benin *Agronomic Research Bulletin* 75: 1-16.**

MOHARRERY, A. AND MAHZONIEH M., 2005. Effect of malic acid on visceral characteristics and Coliform counts in small intestine in the broiler and layer chickens. *International Journal of Poultry Science*, 4: 761-764.

MURRAY M. 2002. Connecting narrative and social representation theory in health research. *Social Science Information*, 41(4), 653-673.

NDOUTAMIA G., and GANDA K., 2005. Determination of hematological and biochemical parameters of small ruminants in Chad. *Med. Vet.*, 156, 4, 202-206.

OKOMBE E.V., LUBOYA Wa L. R., NZUZI M.G., PONGOMBO S.C., 2016. Detection of antibiotic residues in foodstuffs of bovine and avian origin marketed in Lubumbashi (DR Congo). *Journal of Applied Biosciences* 102: 9763 – 9770. ISSN 1997–5902.

Available from: http://dx.doi.org/10.4314/jab.v102i1.11

PAVIC M. & PATRICK G., 2013. National College of Teachers of Internal Medicine. UMVF Francophone Virtual Medical University. 1-28.

ROSOL T.J. and CAPEN C.C.,1997. Calcium - regulating hormones and diseases of abnormal mineral (calcium, phosphorus, magnesium) metabolism. In: *Clinical biochemistry of domestic animals*, p 619 - 687.

SANDERS P, BOUSQUET-MELOU A, C. CHAUVIN and TOUTAIN PL., 2011. Use of antibiotics in farming and public health issues. *INRA Productions Animals* 24: 199–204.

THRALL M.A., GLADE W., ROBIN W. A and TERRY W.C., 2012. Veterinary Hematology and Clinical Chemistry, 2nd Edition. Published by Wiley-Blackwell, Hardcover, 776 pages, £ 62.99 / $ 75.60, ISBN 978-0-8138-1027-0, E-Book ISBN 978-1-118-47273-6.

WHO, WORLD HEALTH ORGANIZATION, 2014. Antimicrobial resistance Global Report on surveillance; summary. 8 pages. Disponible en ligne : http://apps.who.int/iris/bitstream/10665/112647/1/WHO_HSE_PED_AIP_2014.2_eng.pdf?ua=1 [Accessed 15/03/2020]