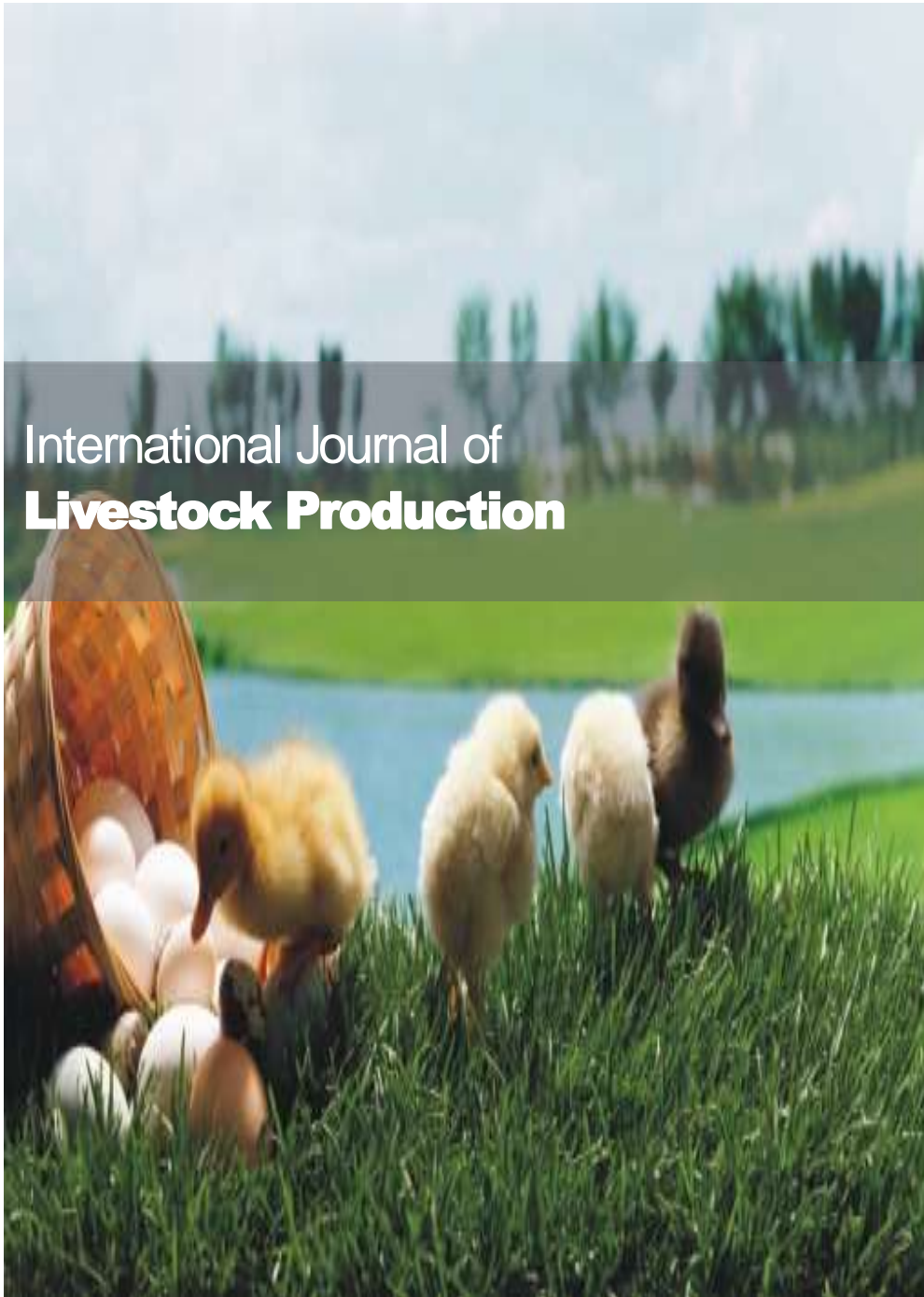


OPEN ACCESS

International Journal of
Livestock Production



April-June 2020
ISSN 2141-2448
DOI: 10.5897/IJLP
www.academicjournals.org

 **ACADEMIC
JOURNALS**
expand your knowledge

About IJLP

The International Journal of Livestock Production (IJLP) is a peer reviewed journal. The journal is published monthly and covers all areas of the subject such as:

Selective breeding in animal husbandry, Health effects of animal cruelty, Feed evaluation and feeding, Diet and animal health, Productivity and product composition (milk, meat and eggs), Sustainable livestock management systems, Whole farm management strategies, Animal work, Systems modelling Traceability, Socio-economic consequences of systems, Impact of animals on soil, water, biodiversity.

Open Access Policy

Open Access is a publication model that enables the dissemination of research articles to the global community without restriction through the internet. All articles published under open access can be accessed by anyone with internet connection.

The International Journal of Livestock Production is an Open Access journal. Abstracts and full texts of all articles published in this journal are freely accessible to everyone immediately after publication without any form of restriction.

Article License

All articles published by International Journal of Livestock Production are licensed under the [Creative Commons Attribution 4.0 International License](#). This permits anyone to copy, redistribute, remix, transmit and adapt the work provided the original work and source is appropriately cited. Citation should include the article DOI. The article license is displayed on the abstract page the following statement:

This article is published under the terms of the [Creative Commons Attribution License 4.0](#)

Please refer to <https://creativecommons.org/licenses/by/4.0/legalcode> for details about [Creative Commons Attribution License 4.0](#)

Article Copyright

When an article is published by in the International Journal of Livestock Production, the author(s) of the article retain the copyright of article. Author(s) may republish the article as part of a book or other materials. When reusing a published article, author(s) should;

Cite the original source of the publication when reusing the article. i.e. cite that the article was originally published in the International Journal of Livestock Production. Include the article DOI

Accept that the article remains published by the International Journal of Livestock Production (except in occasion of a retraction of the article)

The article is licensed under the Creative Commons Attribution 4.0 International License.

A copyright statement is stated in the abstract page of each article. The following statement is an example of a copyright statement on an abstract page.

Copyright ©2016 Author(s) retains the copyright of this article.

Self-Archiving Policy

The International Journal of Livestock Production is a RoMEO green journal. This permits authors to archive any version of their article they find most suitable, including the published version on their institutional repository and any other suitable website.

Please see <http://www.sherpa.ac.uk/romeo/search.php?issn=1684-5315>

Digital Archiving Policy

The International Journal of Livestock Production is committed to the long-term preservation of its content. All articles published by the journal are preserved by Portico. In addition, the journal encourages authors to archive the published version of their articles on their institutional repositories and as well as other appropriate websites.

<https://www.portico.org/publishers/ajournals/>

Metadata Harvesting

The International Journal of Livestock Production encourages metadata harvesting of all its content. The journal fully supports and implements the OAI version 2.0, which comes in a standard XML format. [See Harvesting Parameter](#)

Memberships and Standards



Academic Journals strongly supports the Open Access initiative. Abstracts and full texts of all articles published by Academic Journals are freely accessible to everyone immediately after publication.



All articles published by Academic Journals are licensed under the [Creative Commons Attribution 4.0 International License \(CC BY 4.0\)](#). This permits anyone to copy, redistribute, remix, transmit and adapt the work provided the original work and source is appropriately cited.



[Crossref](#) is an association of scholarly publishers that developed Digital Object Identification (DOI) system for the unique identification published materials. Academic Journals is a member of Crossref and uses the DOI system. All articles published by Academic Journals are issued DOI.

[Similarity Check](#) powered by iThenticate is an initiative started by CrossRef to help its members actively engage in efforts to prevent scholarly and professional plagiarism. Academic Journals is a member of Similarity Check.

[CrossRef Cited-by](#) Linking (formerly Forward Linking) is a service that allows you to discover how your publications are being cited and to incorporate that information into your online publication platform. Academic Journals is a member of [CrossRef Cited-by](#).



Academic Journals is a member of the [International Digital Publishing Forum \(IDPF\)](#). The IDPF is the global trade and standards organization dedicated to the development and promotion of electronic publishing and content consumption.



[COUNTER](#) (Counting Online Usage of Networked Electronic Resources) is an international initiative serving librarians, publishers and intermediaries by setting standards that facilitate the recording and reporting of online usage statistics in a consistent, credible and compatible way. Academic Journals is a member of [COUNTER](#)



[Portico](#) is a digital preservation service provided by ITHAKA, a not-for-profit organization with a mission to help the academic community use digital technologies to preserve the scholarly record and to advance research and teaching in sustainable ways.

Academic Journals is committed to the long-term preservation of its content and uses [Portico](#)



Academic Journals provides an [OAI-PMH](#)(Open Archives Initiatives Protocol for Metadata Harvesting) interface for metadata harvesting.

Contact

Editorial Office: ijlp@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: <http://www.academicjournals.org/journal/IJLP>

Submit manuscript online <http://ms.academicjournals.org>

Academic Journals
73023 Victoria Island, Lagos, Nigeria
ICEA Building, 17th Floor, Kenyatta Avenue, Nairobi, Kenya

Editors

Dr. Tiago Facury Moreira

Clinic and Surgery (Veterinary surgeon)
Federal University of Minas Gerais Brazil

Dr. Ibrahim Seker

Department of Zootecny,
Faculty of Veterinary Medicine
Firat University Türkiye.

Dr. K.N. Mohanta

Fish Nutrition and Physiology Division
Central Institute of Freshwater Aquaculture
Indian Council of Agricultural Research
Kausalyganga, India.

Dr. S.P. Muthukumar

Animal House Facility (B&N)
Central Food Technological Research Institute
CSIR Karnataka, India.

Prof. Maher H. Khalil

College of Agriculture and Veterinary Medicine
Qassim University
Saudi Arabia.

Dr. Ola Safiriyu Idowu

Department of Animal Science
Obafemi Awolowo University
Ile-Ife, Nigeria.

Dr. Sandip Banerjee

Department of Animal and Range Sciences
Hawassa University
Ethiopia.

Dr. Julie Ann Luiz Adrian

University of Hawaii USA.

Prof. Carlos A. Gomez

Nutrition Department
Faculty of Zootecnical
Universidad Nacional Agraria
La Molina, Peru

Prof. Shaukat Ali Abdulrazak

National Council For Science and Technology
Nairobi, Kenya.

Dr. Frederick Yeboah Obese

Department of Animal Science
College of Agriculture and Consumer Sciences
University of Ghana
Legon, Ghana.

Dr. Ming-Che Wu

Taiwan Livestock Research Institute
Taiwan.

Dr. Olubayo Reardon

Ministry of Livestock Development
FAO (Sierra Leon) and FARM-Africa
Kenya.

Prof. Tchouamo Isaac Roger

Faculty of Agriculture
Department of Extension Education and Rural
Sociology
University of Dschang
Dschang, Cameroon.

Editorial Board Members

Dr. Ahamefule Francis Okechukwu

College of Animal Science and Animal Production
Michael Okpara Univ. of Agriculture
Umudike, Nigeria.

Dr. Sudhakar G. Bhandare

Department of Veterinary Public Health
Mathura Veterinary College
UP Veterinary University
Uttar Pradesh, India.

Dr. Shoor Vir Singh

Microbiology Laboratory
Central Institute for Research on Goats
Makhdoom, India.

Dr. Juarez Lopes Donzele

Department of Animal Science
Universidade Federal de Viçosa (Federal University
of Viçosa)
Brazil.

Dr. Richard S. Gates

Agricultural and Biological Engineering Department
University of Illinois
Urbana/Champaign, IL
USA.

Dr. Yavuz Gurbuz

Department of Animal Nutrition
University of Kahramanmaras Sutcu Imam
Turkey.

Dr. Farhad Mirzaei

Animal Production and Management Research
Department
Animal Sciences Research Institute
Karaj, Iran.

Dr. Alireza Seidavi

Department of Animal Science
College of Agriculture
Islamic Azad University
Rasht, Iran.

Dr. Oscar Iram Zavala Leal

Centro Interdisciplinario de Ciencia Marinas
Unidad Piloto de Maricultivos
La Paz, BCS Mexico.

Dr. Rita Flávia Miranda de Oliveira

Department of Animal Science
Universidade Federal de Viçosa (Federal University
of Viçosa)
Brazil.

Dr. Tugay Ayasan

East Mediterranean Agricultural Research Institute
Yuregir/Adana,
Turkey.

Dr. Hakan INCI

Animal Science Department,
Bingol University,
Turkey.

Table of Content

Comparative test of the two final commercial dual-purpose breeds during early growth performance under on-farm management conditions in two districts of Jimma Zone, Ethiopia	52
Belete Jorga, Wondmeneh Esatu ,Mohammed Ali, Wasihun Hassen, Ahmed Seid, and Tekle Olbamo	
Comparative effects of Moringa oleifera powder and soybean meal on the zootechnical parameters of the ISA Brown pullet	60
Jacques S. Adouko, Bienvenu O. M. Koutonin, Kévin S. Kassa, Arnaud S. S. Soha, Fréjus O. H. Ohouko and Jacques T. Dougnon	
Effect of nutritional flushing on reproductive and body weight performance of Abergelle goat does	68
Minister Birhanie, Mulalem Zenebe and Hailai Hagos	
The last of us? An online survey among German farm veterinarians about the future of veterinary training, livestock farming and the profession in general	72
Christian Dürnberger	
The performance of artificial insemination delivery system in Amhara, Oromia, SNNP and Tigray Regions of Ethiopia	84
Kassahun Melesse, Ashenafi Mengistu and Driba Geleti	

Full Length Research Paper

Comparative test of the two final commercial dual-purpose breeds during early growth performance under on-farm management conditions in two districts of Jimma Zone, Ethiopia

Belete Jorga^{1*}, Wondmeneh Esatu², Mohammed Ali³, Wasihun Hassen³, Ahmed Seid³, and Tekle Olbamo¹

¹Department of Animal Science, College of Agriculture and Natural Resource, Jinka University, Ethiopia.

²Ethiopian Agricultural Research Institute, Addis Abeba, Ethiopia.

³Jimma University, College of Agriculture and Veterinary Medicine, Department of Animal Science, Jimma, Ethiopia.

Received 6 November, 2019; Accepted 17 January, 2020

This study was conducted to evaluate the production and reproduction performance of chicken breed under semi-scavenging system of Seka Chekorsa and Omo Nada districts of Jimma Zone. A total of 800 day old chicks were obtained from Debre Zeit Agricultural Research center. 50 day old chicks were distributed with hay box brooder, and the experiment was arranged in a nested design. The result of the current study indicated that male chickens of both breeds in this study reached sexual maturity and slaughter weight within four months in both districts and mature body weights of 1831.25 and 1569.18 g at Seka and 1615.00 and 1586.25g in Omo Nada, respectively for Lohmann dual and Dominant red barred. Although there was no statistically significant difference between the two breeds, Lohmann dual breeds attained age at first egg within 148 days and Dominant red barred (162.25 days) breeds in Seka Chekorsa and 157.50 and 160.25 days, respectively for lohmann and Dominant red barred in Omo Nada district. In general, the current study indicated good performance of Lohmann dual breeds while it needs further study to conclude number of eggs per clutch, number of eggs per hen per year and hatchability for both breeds in both study districts. So this study might be good to consider in the future in other areas.

Key words: Dual purpose breed, on farm evaluation, semi-scavenging, Omo Nada, Seka Chekorsa.

INTRODUCTION

Poultry production is one of the key livestock subsectors of Ethiopia. It plays important roles in terms of generating employment opportunities, improving family nutrition, and empowering women. It is a suitable business for poor

households due to the small quantity of land needed and low investment costs required to start up and run the operation. About 56% (9.6 million) of Ethiopian households have poultry holdings with varying range of

*Corresponding author. E-mail: tekleolbamo@yahoo.com, Tel: +251910554938.

flock size. However, about 80% of the households with poultry keep from 1 to 9 chickens (FAO, 2019).

The total chicken population in the country is estimated to be 56.06 million and 88.19% of this population consists of indigenous chickens characterized by slow growth, late maturity and low production performance such as longer age at first laying, low number of eggs per clutch and hybrid chicken contributes 6.45% and exotic breeds of chicken constituted 5.36% of the poultry population (CSA, 2018). The major targets are set for livestock production during the period of GTP II in which total egg production is projected to increase from 163 million in 2014/15 to 3,938 million by the end of the plan period.

The average number egg-laying period per hen per year is about 4, 4 and 1 for the local, hybrid and exotic breeds, respectively. The average length of a single egg-laying period per hen is estimated to be about 21, 45 and 169 days for local, hybrid and exotic breeds, in that order. The average number of eggs laid per hen per egg-laying period in the country is about 12, 38 and 133 eggs, correspondingly (CSA, 2018). Indigenous flocks are slow in growth rates and very poor in egg productivity. Mean body weights at 8 and 16 weeks of age could be as low as 242 and 621 g, respectively (Nigussie, 2011). Although large numbers of chicken were recorded in Ethiopia; their production and reproduction performance was low. There is notable demand for poultry products associated with the increase in family income. To meet the ever-increasing demand for meat and eggs, introduction of superior/exotic breed has been proposed as one of the plausible option (Haftu, 2016).

In an effort to avail high yielding and alternative dual purpose poultry breeds to village poultry production system, two self-reproducing dual purpose chicken breeds were introduced: Red barred D922 and Lohmann Dual. Commercial breeding companies produced dual purpose breeds (DPB) using crosses of meat and layer lines, such as Lohmann Dual (LD) (Lohmann Tierzucht, Cuxhaven), Dominant Red Barred (Grimaud Frères, France) using the sex-linked dwarf gen. This major gen reduced the body weight of the females by about 25% while the males grow at a normal rate. Lohmann Dual as the name implies is the strain developed by Lohmann Tierzucht for dual purpose birds. The chickens have white feathers and lay eggs lighter in shell color as compared to normal brown eggs. Lohmann dual combines good laying performance with an acceptable gain on meat (Urselmans et al., 2015). Fed with broiler diets for 70 days, the Lohmann dual cockerels attained a live body weight of 3 kg. The weight of the carcass was around 2 kg. Performance tests have shown that Lohmann Duals have sufficient performance in meat and egg production (Urselmans et al., 2015). Dominant red barred are provided by DOMINANT CZ company and have good feather cover, high egg production, 300 eggs

per year, higher egg weight at the start of laying period, high number of hatching eggs and strong day old chicks (<http://dominant-cz.cz> pas). The performance of these chickens should be known under farmers' management condition before wider distribution to villages. Demonstration and evaluation of new chicken strains in villages in semi-scavenging production system is crucial to enhance the production and productivity of chicken throughout the zone and beyond. Hence, this study was designed to test these breeds in two woredas of Jimma zone. Therefore, the objective of this study is to evaluate the production and reproduction performance of red barred D922 and Lohmann Dual purpose chicken breeds under semi-scavenging system of Jimma Zone.

MATERIALS AND METHODS

Descriptions of the study area

The field experiment was conducted in two different districts namely Seka Chekorsa and Omo Nada out of 18 districts in Jimma Zone. The study areas were selected purposely on the basis of accessibility to road which enables close supervision of the experiment and high crop production potential areas.

Seka Chekorsa

Seka Chekorsa is a district in Jimma zone located at a distance of 355 km, southwest of Addis Ababa. The district is located at an altitude ranging between 1580 and 2560 meters above sea level. The district receives mean annual rainfall, ranging between 1,200 and 2,800 mm. The mean minimum and maximum daily temperatures of the area are 12.6 and 29.1°C, respectively. The district is suitable for livestock keeping and reported to have a total human population of 210,176, of whom 52.4% are males, and females 47.6% and nearly 4% of the population are urban dwellers (Seka Chekorsa District Finance and Economy Office Data, 2015). Cereal grains, enset, beans and sweet potatoes are widely grown. The district is divided into two agro-ecological zones; Dega (highland) and Woinadega (mid land), accounting for about 18 and 82% of the total land area, respectively. The rainfall pattern is unimodal, starting in March to April and reaching its peak in between July and September (Seka Chekorsa District Agriculture and Environmental Protection Data, 2013).

Omo Nada

It is a district available in the eastern side of Jimma town within Jimma zone Oromia regional state and is located at a distance of 285 km from Addis Ababa, on the road to Jimma. Omo Nada is bordered on the south by the Gojeb River which separates it from the Southern Nations, Nationalities and Peoples Region (SNNPR), on the west by Dedo, on the northwest by Kersa, on the north by Tiro Afeta, on the northeast by Sokoru, and on the east by the Omo River which separates it from the SNNPR. Teff and wheat are important cash crops. The altitude of this district ranges from 1000 to 3340 meters above sea level. According to the District Finance and Economy Office Data, 2015, total population for this district is 272,990 (152,709 men and 120,281 women); 12,215 or 4.92% of its population were urban dwellers. Geographically, it is located 30°N

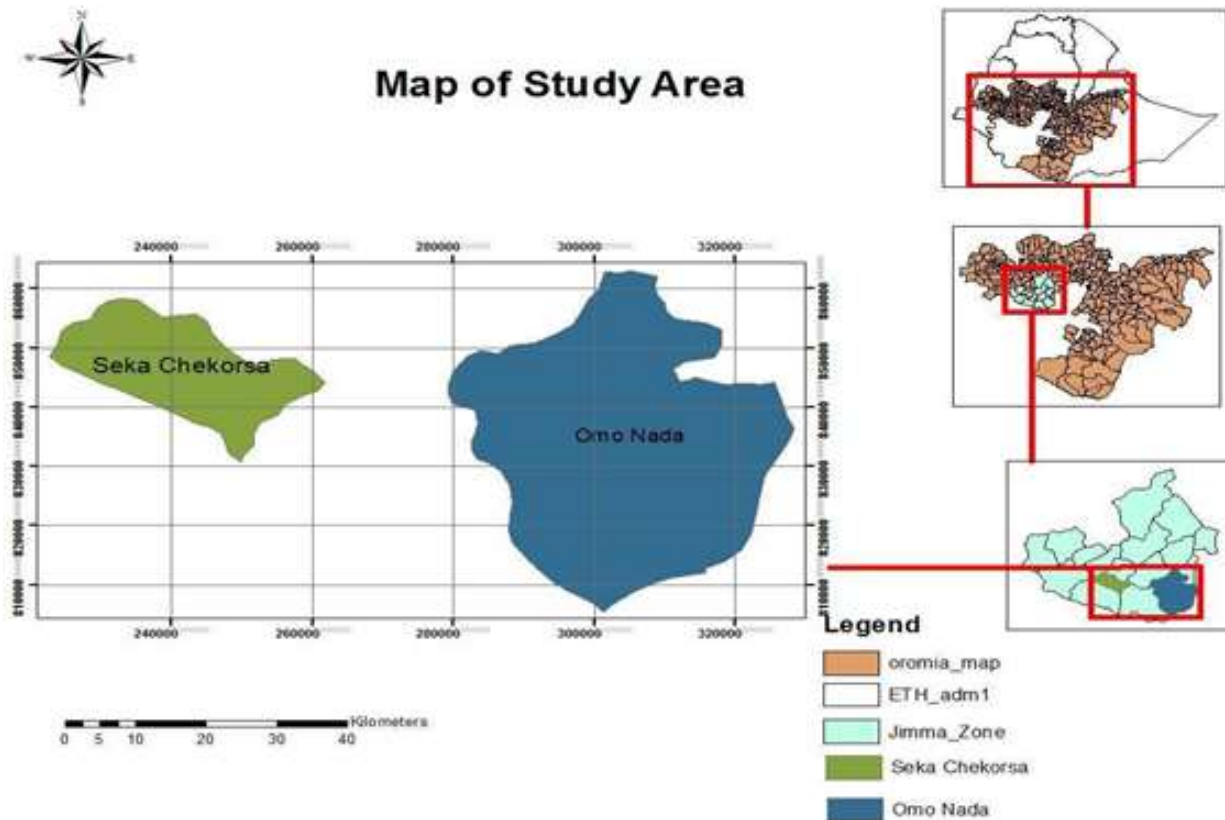


Figure 1. Map of the study area.

370 15' latitude and longitudes (<https://en.wikipedia.org/wiki/OmoNada>, 12/07/2017). According to the District Livestock and Fishery Office, Omo Nada covers an area of 165,602.66 ha (Figure 1).

Sample size and sampling techniques

Totally 30 farmers from both study districts were asked for their past experience whether they have kept exotic chickens. Accordingly, 15 farmers were asked in each district. From 15 farmers questioned in Omo Nada District 53.3% (8) farmers were non-experienced and 46.7% (7) farmers were experienced. From 53.3% of non-experienced farmers 50% (4) farmers voluntarily construct house and cover other costs needed, and from 46.7% of experienced farmers 57% (4) farmers voluntarily construct houses and manage the experimental chicks. Similarly, in Seka Chekorsa district out of the 15 farmers questioned 53.3% (8) were experienced and 46.7% (7) were non-experienced. Accordingly, from 53.3% of experienced farmers 50% (4) farmers voluntarily cover the input costs including house construction, and similarly from 46.7% of non-experienced farmers 57% (4) voluntarily input costs needed from farmers. Based on the questionnaire, eight farmers from Seka Chekorsa District and eight farmers from Omo Nada District were selected in consultation with Seka Chekorsa and Omo Nada district Livestock and Fishery Resource Development Office. Participating households and developmental agents (DAs) were trained on the construction of house, and use of hay box brooder, health, feeding and data recordings before the commencement of the experiment.

Management of experimental chicken

A total of 800 day old chicks vaccinated against Marek's disease and Newcastle (400 Red barred D922 and 400 Lohmann Dual purpose chicks) were obtained from DebreZeit Agricultural Research Center (DZARC) and transported to the testing sites of Seka Chekorsa and Omo Nada district. They were brooded using two hay box brooder of 50 chick capacity (30 cm * 57 cm * 57 cm for heat provider and 30 cm * 127 cm * 127 cm for feeding and day time stay for the first 8 weeks' (Solomon, 2012). Separate house was constructed as recommended and the farmers were provided with commercial feed and trained for management of experimental chicks.

Data collection and parameters estimated

Data were collected on daily feed intake, body weight was recorded at day old, and every week (from week 1-8) brooding, during growing (10-16 weeks at two weeks' interval) period using electronic balance of 25 kg capacity. Daily body weight gain (difference in body weight values between two consecutive measurements divided by the number of days), feed provided, hen day egg production, hen housed egg production.

Experimental design

Three stage nested design was used for this experiment. Accordingly, status was nested within the district in which each level

of status was nested within each level of districts; similarly breed was nested under status nested within districts in which each level of breed was nested under each level of status. The experiment was arranged by assigning randomly chicken from two breeds to a total of 16 farmers selected from two districts, which were grouped into two as farmers having experience and not having experience.

Statistical analysis

Data collected were subjected to Analysis of Variance (ANOVA) using generalized linear model of statistical analysis system (SAS) version 9.2 (SAS, 2008). Proc GLM Since all the levels of factors under study were fixed, $H_0: \tau_i = 0$ is tested by $MS \tau_i / MSE$ and $H_0: \beta_j(i) = 0$ is tested by $MS(\beta_j(i)) / MSE$. Least significance difference test was used to separate the means that showed significant difference (5%) at five percent significant level. Data collected on hen housed egg production (HHEP), and Hen day egg production (HDEP) were analyzed using chi-square test for association. The model for this experiment was as follows: The model used,

$$y_{ijkl} = \mu + wx + \tau_i + \beta_j(i) + k(ij) + \epsilon(ijk)$$

Where, y_{ijkl} =the observation taken, μ =the overall mean wx = regression coefficient of initial weight (day old body weight) τ_i =the i^{th} fixed effect of district, $i=1,2$ $\beta_j(i)$ =the j^{th} level of status nested with in i^{th} level of district, $j=1,2$ $k(ij)$ =the k^{th} level of breed nested with in j^{th} level of status nested with in i^{th} level of district, $k=1,2$ $\epsilon(ijk)$ =error term. The farmers nested with in j^{th} status assumed to have followed the same management.

RESULTS AND DISCUSSION

Growth performance

Body weight

The body weight measurements of study breeds in Seka Chekorsa and Omo Nada districts are presented in Table 1. There was significant ($p < 0.05$) difference between two breeds at 4, 8, and 12 weeks in both study districts. This could be attributed to the genotypic difference of breeds and farmers' management differences. There was significantly ($p < 0.05$) higher body weight of LD (274.5, and 653.75 g) breeds than DRB (239.5 and 576.00 g) at week 4 and 8 in Seka District. Similarly, in Omo Nada District LD (323.75 and 739.25 g) males attained more than DRB (228.00 and 540.00 g) at 4 and 8 weeks. But in both study districts DRB females attained (838.75 and 937.25 g), respectively at Seka Chekorsa and Omo Nada districts at 12 weeks.

The result of current study indicated that male chickens of both breeds in this study reached sexual maturity and slaughter weight within 4 months with mature body weights of 1831.25 and 1569.50 g in Seka chekorsa whereas 1615.00 and 1586.25 g in Omo Nada, respectively for LD and DRB breeds. The average slaughter age for exotic broiler chicken breeds is between 40-45 days, whereas indigenous breeds are usually slaughtered between 8 to 12 months. Average slaughter weight, for both indigenous and exotic broiler breeds, is about 1300

g (Francom and Counselor, 2017). The body weight development in these two breeds indicates that the breeds have a good potential for meat production. This might be associated with the genetic potential for fast growth in the breeds used in current study.

Mean age at slaughter weight of 1500 g of the male chickens of the Gomma Woreda was reported 8.62 months (Meseret, 2010) was lower than current finding even though it doubled the average slaughter age of current breeds. This might be due to easy awareness of farmers, the suitability of the agro ecology, types of crops cultivated and the potential of breeds in current study to attain higher slaughter weight in lower growth period in comparison to indigenous and dual purpose chickens introduced earlier. The average body weight recorded in the first 20 weeks of age was 1030 g in the case of female chicken at 20 weeks as indicated by Kasa and Saba (2016) for koekoek breed. This is also slightly similar to the result of current study for LD breed in both study districts but lower than body weight for DRB female. This might be due to good management of farmers, crop type cultivated and breeds genotypic ability to gain more weight in this study.

Average daily body weight gain

The overall daily body weight gain results of study breeds during 16 weeks are shown in Table 2. There was statistically significant ($p < 0.05$) effects of breed within districts on average daily body weight gain during 4th, 8th week and 12-week weight gains of female, 16-weeks weight gain of male chicken. The result of current study indicated that at weeks 4 and 8 DRB had significantly higher daily body weight gain (10.25, 10.00 g and 11.50, 19.50 g, respectively of DRB and LD breeds at Seka chekorsa District for pooled sex. This might be due to the dwarf gene expression of female LD breeds towards sexual maturity since it is not separated until eight weeks due to difficulty of differentiating sex and are also less competent with male chickens during feeding. Also the result indicated that there was significantly higher daily gain of female DRB breeds at 12th weeks than LD in both districts. Significantly higher daily gain was reported for LD male chicks than DRB at 16th weeks.

Daily feed intake

The daily feed intake measurement of study breeds under current study during brooding period is shown in Table 3, respectively. The result of the current study also showed that there was statistically significant ($p < 0.05$) difference between breeds in feed intake at weeks 1 and 2, in which LD was consumed (17.00 and 20.00 g/day/chick) at Seka Chekorsa district whereas 19.25

Table 1. Mean body weight of study breeds in Seka chekorsa and Omo Nada districts (in g/chicken) Growth period for both sex.

Growth period in weeks	Seka Chekorsa		OmoNada	
	Mean±SE		Mean±SE	
	LD	DRB	LD	DRB
4	274.50±12.6 ^a	239.50±4.50 ^b	323.75±5.72 ^a	228.00±3.34 ^b
8	653.75±11.92 ^a	576.00±14.91 ^b	739.25±54.24 ^a	540.00±16.48 ^b
12(M)	1415.25±40.11 ^a	1094.50±27.21 ^b	1258.25±74.06 ^a	1092.50±21.54 ^b
16(M)	1831.25±91.34	1569.50±18.82	1615.00±48.54	1586.25±30.80
12(F)	803.00±31.12 ^b	838.75±13.30 ^a	782.00±20.80 ^b	937.25±48.79 ^a
16(F)	1098.50±86.76	1159.25±16.43	971.00±29.86	1154.75±25.90
20(F)	1255.00±19.36	1942.93±60.46	1185.00±31.22	1900.00±52.91

M and F indicates male and female; Significance difference at ($p < 0.05$); SE=Standard error. ^{a,b}Different superscripts in the same row indicates LD=Lohmann dual; DRB=Dominant red bared.

Table 2. Mean daily body weight gain of LD and DRB breeds at different ages in Seka chekorsa and OmoNada districts for both sex (in g/chicken/day) .

Growth period in weeks	Seka Chekorsa		OmoNada	
	Mean±SE		Mean±SE	
	LD	DRB	LD	DRB
4	10.0±2.67 ^a	10.25±0.75 ^b	13.25±1.03 ^a	5.25±1.60 ^b
8	11.50±2.10 ^b	19.50±1.55 ^a	10.25±3.06 ^b	13.75±1.65 ^a
12(M)	14.50±0.64	17.25±1.43	7.00±2.04	8.75±0.62
16(M)	20.00±1.91 ^a	18.50±0.64 ^b	13.00±2.04 ^a	6.50±0.86 ^b
12(F)	7.00±1.08 ^b	10.25±0.47 ^a	6.25±1.88 ^b	14.50±1.50 ^a
16(F)	14.00±3.36 ^a	12.50±1.32 ^b	3.25±1.03 ^b	6.75±0.62 ^a

M and F indicates male and female; Significance difference at ($p < 0.05$); SE=Standard error. ^{a,b}Different superscripts in the same row indicates LD=Lohmann dual; DRB=Dominant red bared.

Table 3. Mean daily feed intake of LD and DRB breeds at different ages in Seka Chekorsa and Omo Nada districts for both sex (in g/chicken/day).

Growth period in weeks	Seka Chekorsa		OmoNada	
	Mean±SE		Mean±SE	
	LD	DRB	LD	DRB
1	17.00±0.91 ^a	15.25±0.48 ^b	19.25±0.47 ^a	16.25±0.48 ^b
2	20.00±0.40 ^a	17.00±0.40 ^b	20.25±0.25 ^a	17.25±0.25 ^b
3	23.25±1.03	19.75±1.25	20.75±1.65	21.5±0.86
4	28.25±0.62	27.25±0.62	26.00±1.08	25.25±0.25
5	33.50±1.70	35.50±1.75	35.00±1.08	35.25±1.79
6	40.25±1.10	40.25±1.03	41.50±1.19	40.75±1.10
7	42.25±0.47	41.50±1.25	42.50±0.86	41.50±0.64
8	42.25±0.47	41.75±0.62	42.50±0.86	41.75±0.62

LD=Lohmann dual; DRB=Dominant red bared; SE=Standard error; a b Different superscripts in the same row indicates significance difference at ($p < 0.05$).

and 20.25g in Omo Nada district. But DRB consumes (15.25 and 17.00 g/day/chick) in Seka Chekorsa district

and (16.25 and 17.25 g) in Omo Nada District. This lower feed intake in DRB at earlier age might be due to breeds

Table 4. Mean feed conversion ratio of study breeds in Seka Chekorsa and OmoNada districts.

Growth period in weeks	Seka Chekorsa		OmoNada	
	Mean±SE		Mean±SE	
	LD	DRB	LD	DRB
1	4.50±0.57 ^b	4.75±0.50 ^a	6.25±2.21 ^a	4.75±1.5 ^b
2	3.5±0.57	3.25±0.50	2.00±01	2.25±0.50
3	1.75±0.95	2.25±0.05	1.75±0.95	2.00±0.30
4	3.50±3.00	2.50±0.57	2.00±00	4.75±2.36
5	2.25±0.50 ^b	4.75±2.21 ^a	1.50±0.57 ^b	2.75±0.50 ^a
6	3.00±0.81 ^b	3.25±0.50 ^a	2.50±0.57 ^b	5.00±1.15 ^a
7	2.50±0.57 ^b	5.25±1.50 ^a	8.50±1.29 ^a	4.85±0.50 ^b
8	4.25±1.50 ^a	2.25±0.50 ^b	4.50±1.91 ^a	3.25±0.95 ^b

Where SE=standard error; FCR=feed conversion ratio; FI=feed intake; DBWG=daily body weight gain; LD=Lohmann dual; DRB=Dominant red barred; a b Different superscript in the same raw indicates significant difference at $p<0.05$.

genotypic difference as well as farmer's management difference in terms of feed and water provision. The result of current study shows that both breeds in the current study had higher feed intake at 4th and 8th week in comparison to Fayoumi chicken breeds which consumes 16.16 and 23.74 g/day, respectively in 4th and 8th week (Simeamelak et al., 2011). This might be attributed to the higher consuming ability of breeds in the present study and the fact that Fayoumi are light breeds as well as it might be due to good feeder and feeding system undertaken in the current study.

Feed conversion ratio (FCR) of two study breeds

Feed conversion ratios of two study breeds are presented in Table 4. There was significant ($p<0.05$) difference between two study breeds at week 1, 5, 6, 7 and 8 in terms of FCR in both study districts, in which LD (4.25) showed significantly ($p<0.05$) higher feed conversion ratio than DRB (2.25) at week 8 in Seka Chekorsa district. This indicates that DRB breeds are efficient converter of feed into daily body weight gain. This might be attributed to farmer management differences in terms of provision of water and health care. But there was significantly ($p<0.05$) higher feed conversion ratio of DRB at week 1, 5, 6 and 7 in Seka Chekorsa District showing that LD breeds efficiently converted feed intake into daily body weight gain. This might be attributed to higher daily body weight gain of LD breeds in aforementioned respective weeks with slightly similar feed intake with DRB and concluded as LD breed is efficient having the same quantity and suitability of feed provided. In OmoNada district LD breed had significantly ($p<0.05$) higher FCR at weeks 1, 7 and 8 than DRB, implying that LD breed was less efficient in feed conversion than DRB. But DRB breed had higher FCR at weeks 5 and 6 which also similarly shows in turn DRB breeds are less efficient in this week. These

differences might be due to farmers' management in terms of feed and water provision.

The results of the present study for both breeds in both study districts showed earlier age at first egg (AFE) in comparison to the average age at first egg laying recorded for Koekoek breeds at farmers management condition reported as (219) days (Kasa and Saba, 2016) in Jimma zone. This might be attributed to better managements in the current study. But similar breeds were attained earlier under farmer's management condition (AFE) 142 days at Areka areas, SNNPR, Ethiopia (Aman et al., 2016). The result of the present study for both breeds in both districts was slightly in agreement with the report of 160.5, 165.6 and 153.3 days for Isa brown (IB), Bovan brown (BB) and PK, respectively (Desalew et al., 2013) under village production system in Ada'a and Lume districts of East Shewa, Ethiopia. The current finding for two breeds in both districts also showed earlier AFE than the report of (Aman et al., 2017) 177, 171 and 213 days for Sasso, Bovans brown and local breeds respectively under village production system. This also might be due to breeds in current study can attain sexual maturity earlier and the easy awareness of farmers in this study (Table 5).

Egg production of dominant red barred and Lohmann dual purpose breeds

The hen day and hen housed egg production (%) of two study breeds are presented in Table 6. The hen housed and hen day egg production was 53.8 and 71.4% for LD chicken during two-week period of egg production and this increased to 73.1 and 78.9% respectively during the next two weeks. There were 56.7 and 80.0% hen housed and hen day egg production for DRB during the 1st two weeks of egg laying and which was also increased to 75.3 and 82.4% respectively of hen

Table 5. Age at first egg lay and body weight at first egg laying of study breeds.

Parameter	Seka Chekorsa		OmoNada	
	Mean±SE		Mean±SE	
	LD	DRB	LD	DRB
Age at first egg	148.00±15	162.25±21	157.50±15	160.25±26
Body weight at 1 st egg	1255.00±19.36	1942.93±60.46	1185.00±31.22	1900.00±52.91

LD=Lohmann dual; DRB=Dominant red bared; SE=Standard error; BWt=body weight.

Table 6. Hen day and hen housed egg production (%) of LD and DRB breeds in study districts.

Variable	1st two weeks of egg lay		2nd two weeks of egg lay	
	HDEP%	HHEP%	HDEP%	HHEP%
Breeds				
LD	71.4	53.8	78.9	73.1
DRB	80	56.7	82.4	75.3
X2 -value	0.52	0.45	0.007	0.87
p-value	p>0.05	p>0.05	p>0.05	P>0.05

HDEP=Hen day egg production; HHEP =Hen housed egg production; LD=Lohmann; DRB=Dominant red barred.

housed and hen day egg production during the next two weeks of egg laying.

This result indicates slightly better egg production of DRB chicken in comparison to LD. This might owe to better performing ability of DRB under farmers' condition. The result of the current study indicated better performance of both breeds in comparison to report of 49.3, 54.8 and 44.2 and 49.2% of hen housed and hen day egg production respectively for Fayoumi and Rhode Island Red crosses with local Kei (Misiba and Abera, 2013) at Bersa water shade in Gurage Administrative zone, under farmer's management condition. According to Meseret (2010), the average daily egg production/head of the *Isa Brown* breed and indigenous chickens are reported to be 0.70 and 0.046 eggs per hen per day, which were also lower than that of current finding. This might be due to good performance of breeds in current study under farmer's management system than breeds in previous study. The report of Wondmeneh (2015) indicated 54.83, 51.6 and 37.64% of hen housed egg production for commercial, improved and indigenous chicken respectively at month three under farmer management in Horro district, which was lower than the finding in current study for both breeds in the first one month.

CONCLUSIONS AND RECOMMENDATIONS

The result of the current study indicated good performance of Lohmann dual male in both study districts under farmer management condition in terms of body weight, having increased productivity with improved management

housing, feeding, watering and health care). The result also indicated that male chickens of both breeds in this study reached sexual maturity and slaughter weight within four months in both study districts. There were mature body weights of 1831.25 and 1569.18 g at Seka and 1615.00 and 1586.25 g in Omo Nada, respectively for Lohmann dual and Dominant red barred.

In general, the current study indicated good performance of Lohmann dual in both study districts in terms of body weight and age at sexual maturity under farmers' management condition. There is need for further study to conclude number of eggs per clutch, number of eggs per hen per year, hatchability and farmer preferences for both breeds. The study breed can perform better with good ration and management (using appropriate feeder and waterier). So this study might be good to consider in the future in other areas and the breeds should be distributed in study district. Finally using hay-box brooder is the best choice in the rural area to grow chicks without mother hen.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Aman G, Bangu B, Bereket Z, Desta G, Abit T, Edige A, Hamid J (2017). Production performance of Sasso (distributed by ethio-chicken private poultry farms) and Bovans brown chickens breed under village production system in three agro-ecologies of Southern Nations, Nationalities, and Peoples Regional State (SNNPR), Ethiopia. International Journal of Livestock Production

- 8(9):145-157.
- Aman G, Melese Y, Mesifen , Adissu J, Mebratu A, Asirat T, Endrias D (2016). Demonstration and Evaluation of Dual Purpose Chicken Potchefstroom Koekoek at Areka areas, SNNPR, Ethiopia. *Global Journal of Science Frontier Research* 16(2):37-42.
- CSA (Central Statistical Agency) (2018). Federal democratic republic of Ethiopia.,(April). *Agricultural Sample Survey Volume II Report on Livestock and Livestock Characteristics*.
- Desalew T, Harpal S, Ashenafi M, Wondmeneh E, Tadelle D (2013). Study on productive performances and egg quality traits of exotic chickens under village production system in East Shewa, Ethiopia. *African Journal of Agricultural Research* 8(13):1123-1128.
- FAO (2019). Poultry Sector Ethiopia. *FAO Animal Production and Health Livestock Country Reviews*. No. 11. Rome.
- Francom MG, Counselor A (2017). *Ethiopian Demand for Chicken Meat is Expected to Grow*. Addis Ababa. Ethiopia. ET1712. 6/7/2017.
- Haftu KS (2016). Exotic Chicken Status, Production Performance and Constraints in Ethiopia: A Review. *Asian Journal of Poultry Science*. 10(1): 30-39.
- Kasa B, Saba H (2016). Demonstration and Performance Evaluation of Koekoek Chicken at Jimma Zone, South Western Ethiopia. *Journal of Biology, Agriculture and Health care* 6(15):53-58.
- Meseret M (2010). Characterization of village chicken production and marketing system in GommaWereda, Jimma Zone, Ethiopia, MSc thesis, Jimma University.
- Nigussie D (2011). Breeding programs for indigenous chicken in Ethiopia: analysis of diversity in production systems and chicken population. PhD thesis. Wageningen University, the Netherlands. 148 pp.
- SAS (2008). *Statistical Analysis System. Version 9.2*, SAS Institute Inc., Cary, NC., USA.
- Simeamelak M, Amare A (2011). Introduction and evaluation of modified hay-box brooder, Fayoumi chicken and layers housing, addressing small-scale semi-intensive poultry farming at Beresa Watershade, Gurage Zone, Ethiopia. *International Journal of Livestock Production* 2(8):124-128.
- Solomon D (2012). Hay Box Brooder: A Milestone to Increase Rural Households Poultry Production. *INFPD Good Practices of Family Poultry Production Note No 01*.
- Urselmans S, Damme K, Schmidt E (2015). Leistung sprüfung von Zweinutzungshühnern- die Tiere sind kompakt und ruhig. *DGS MAGAZIN* 1:33-37.
- Wondmeneh EW (2015). Genetic improvemen in indigenous chicken of Ethiopia. PhD dissertation, Wageningen University, the Netherland.

Full Length Research Paper

Comparative effects of *Moringa oleifera* powder and soybean meal on the zootechnical parameters of the ISA Brown pullet

**Jacques S. Adouko^{1*}, Bienvenu O. M. Koutonin¹, Kévin S. Kassa², Arnaud S. S. Soha¹,
Fréjus O. H. Ohouko¹ and Jacques T. Dougnon¹**

¹Research Unit in Applied Microbiology and Pharmacology of Natural Substances, University of Abomey-Calavi,
01 BP 2000 Cotonou, Benin.

²Laboratory of Animal Biotechnology and Meat Technology (LABTV), University of Abomey-Calavi,
01 BP 2009 Cotonou, Benin.

Received 10 October, 2019; Accepted 12 March, 2020

Poultry farming is an important sector of the Beninese agriculture. But this sector is facing economic difficulties. The aim of this study is to evaluate the effects of *Moringa oleifera* powder and soybean meal on zootechnical parameters in the ISA Brown pullet. For this purpose, the experiment was carried out on a total of 250 day-old chicks with an initial average weight of 40 ± 1 g. Among these chicks, 25 subjects were used for the digestibility test and the rest were grouped into cinq (05) batches of 45 chicks fed with different rations. The test lasted 56 days. The apparent digestibility of the dry matter varied significantly from 50.0 ± 9.18 to 50.42 ± 16.11 at the 5% threshold between the different batches. Feed consumption of chicks of the different experimental batches did not show any significant variation, while for the feed conversion rate, weight gain and average daily gain, most averages vary significantly between batches and weeks. It brings out that *M. oleifera* powder improves the feed conversion and growth rates of ISA Brown pullets fed with a feed containing *M. oleifera* powder at different incorporation rates.

Key words: *Moringa oleifera*, soybean, ISA Brown laying hens, zootechnical parameters.

INTRODUCTION

Benin's agriculture, which employs 70% of the working population, is one of the vital sectors of the economy. It contributes nearly 40% to GDP (INSAE, 2008). However, it does not significantly reduce poverty. The consequences of this are undernourishment and more particularly a lack of animal protein (FAO, 2010). Indeed, the animal protein coverage rate is very low in developing countries (Omole, 2006). Thus, in order to ensure food

security for rural and urban populations, the new livestock development programmes are oriented towards the promotion of short-cycle animal species in general and poultry in particular (FAO, 2000). In this dynamic, poultry farming is a major component of farmers in animal production. It is a sector that represents a complementary source of income in which to draw in emergency case. However, it must be noted that this farming is subject

*Corresponding author. E-mail: adoukojacques3@gmail.com. Tel: (00229) 96157423.

to multifactorial constraints leading to a high mortality rate (65 to 70%) between 0 and 2 months and a drop in zootechnical performance (Laurenson, 2002). Among these constraints, those related to food occupy a prominent place, characterized by the high cost of certain raw materials, in particular soybean meal, which represents a raw material used in conventional food resources. But it should be noted that access to these resources is limited for many farmers due to their ever-increasing costs (FAO, 2010). The use of non-conventional local foods in the feeding of herbivorous monogastric animals appears to be a reasonable alternative to conventional commercial foods (Aboh et al., 2002). *Moringa oleifera* is a legume that is increasingly used in animal feed, especially for laying hens and broilers (Raphaël et al., 2015; Mufwaya and Kiatoko, 2016). In addition to the nutritional role, it is shown that the ethanolic extract of *M. oleifera* leaves has antibacterial activity against *Staphylococcus aureus* strains (Dougnon et al., 2011). The extracts of *M. oleifera* leaves have antioxidant and anticancer activities (Charoensin, 2014; Pamok et al., 2012). It is therefore urgent to propose endogenous alternatives to make poultry production in Benin competitive. An endogenous solution must be sought to reduce the cost of production in laying hens. The main aim of the study is to evaluate the effect of *M. oleifera* powder on the zootechnical parameters of the ISA Brown pullet.

MATERIALS AND METHODS

Study area

Part of the experiment took place at the Centre Cunicole de Recherche et d'Information (CECURI) located next to the EPAC Department of Animal Production and Health (D/PSA) on the Abomey-Calavi University Campus (UAC), and the other part on a farm located in Togodo not far from the Catholic Church of Togodo.

Animal material

The experiment was carried out on two hundred and fifty ISA Brown pullets imported from France and divided into five batches of fifty subjects each, including four experimental batches and a control batch. The average body weight of the chicks was 40 ± 1 g at reception.

Plant material

The plant material consisted of the whole leaves of *M. oleifera*.

Experimental ration

To obtain *M. oleifera* flour, the leaves were harvested and dried on sheets metal in the open air at a laboratory temperature away from the sun until completely dry leaves were obtained. These dry leaves were then ground to powder by the LFJ-40B grinding device at the EPAC feed mill. For the experiment, five types of experimental diets

were used. The first is the control feed (Batch 1), the second is composed of 5% *M. oleifera* in substitution for soybean meal (Batch 2), the third is composed of 10% *M. oleifera* in substitution for soybean meal (Batch 3), the fourth is composed of 15% *M. oleifera* in substitution for soybean meal (Batch 4), and the fifth is composed of 20% *M. oleifera* in substitution for soybean meal. Different raw materials were used for this composition. The feed is mainly based on corn, roasted soya, bran, flesh concentrate 5% (Belgian origin), fish meal, cooking salt and oyster shell (Table 1).

Evaluation of zootechnical parameters

Twenty-five ISA Brown chicks divided into 5 batches of five were used for the digestibility test of *M. oleifera*. The chicks were raised for 8 weeks in rabbit cages of 80 cm x 50 cm and 30 cm, each equipped with water trough and feeding trough. Tarpaulins are placed under the individual cages to collect droppings from each batch.

(i) 250 chicks were reared up to laying in variable size fence pens at each phase, meaning 1 m² for 50 subjects during the chick phase; 1 m² for 10 subjects during the pullet phase and 1 m² for 5 subjects during the laying phase. Each pen is equipped with water trough and feeding trough.

The batches constituted for the test are in numbers of five: Batch 1; Batch 2; Batch 3; Batch 4 and Batch 5. The details of the constitution of each batch are described in Table 2. The amount of feed refused was weighed daily, the amount of feed consumed weekly was determined by making the difference between the total amount served per week and the sum of the daily refusals. The sum of the weekly consumptions allowed us to obtain the total quantity of feed consumed. Individual weight gain of the chickens was performed every 7 days. The chickens were vaccinated against Newcastle disease, Gumboro disease and infectious bronchitis. They have also been treated against coccidiosis and helminths. They received vitamin (anti-stress) to fight stress. The data collected made it possible to calculate the following zootechnical parameters:

(i) Feed consumption (CA)

It is obtained by the formula:

$$CA = \frac{\text{Amount of feed distributed (g)} - \text{Amount of feed refused (g)}}{\text{Number of animals}}$$

(ii) Average daily gain (ADG)

The ADG was calculated according to the formula: $ADG = (Wf - Wi)/d$ with :Wf = final average weight, Wi = initial average weight and d = duration in days.

(iii) Feed conversion ratio (FCR)

It was obtained by the formula:

$$FCR = \frac{\text{amount of feed consumed during a given period (g)}}{\text{weight gain during this period (g)}}$$

Digestibility test

It was carried out on a total of twenty-five chickens from the 14th to the 21st day. The chickens were placed in cages measuring 45 cm x 37.5 cm x 33 cm. These cages are each equipped with two

Table 1. Gross composition of experimental diets.

Gross composition					
Ingredients (kg)	R0	R5	R10	R15	R20
Maize grain	58.98	58.98	58.98	58.98	58.98
Wheat bran	10	10	10	10	10
Soybean meal	18	17.1	16.2	15.3	14.4
Fish meal	7	7	7	7	7
Concentrated broilers ¹ (5%)	5	5	5	5	5
iodized salt	0.02	0.02	0.02	0.02	0.02
Oyster shell	1	1	1	1	1
Moringa oléifera	0	0.9	1.8	2.7	3.6
Total	100	100	100	100	100
Chemical composition					
	R0	R5	R10	R15	R20
Dry matter (%)	87	87	87	87	87
Crude fiber (%)	2.88	2.90	2.92	2.94	2.97
Metabolisable energy (kcal/kg)	2945.10	2953.33	2961.56	2969.78	2978.01
Crude protein (%)	18.09	17.95	17.82	17.62	17.55
Lysine(%)	1.6	1.03	1.01	0.99	0.96
Methionine(%)	0.39	0.38	0.38	0.37	0.37
Calcium(%)	1.20	1.21	1.22	1.23	1.24
Total phosphorus (%)	0.43	0.42	0.42	0.42	0.42

¹Concentrated broilers composition per kg : Vitamins: A 200000 UI; D3 40000 UI; E 600 mg; K3 40 mg; B1 30 mg; B2 100 mg; B3 (calpan) 200 mg; niacine 800 mg; B6 40 mg; B12 0.5 mg ; Folic acid 20 mg ; Biotin 2 mg; chlorure de choline 10000 mg, Minéraux: Cu 180 mg; Mn 1200 mg; Zn 1000 mg; Fe 800 mg; Se 3 mg ; I mg ; Ca 2.5 mg; P 2.5 mg ; available P 3.85 mg ; Na 2.3 mg; methionine 4.10 mg ; cysteine methionine 4.80 mg, lysine 5.4 mg ; 8phytase FYT/kg 30769; metabolisable energy Kcal/kg 1810.

Table 2. Batch composition.

Batches	Description	Dosage
1	<i>M. oleifera</i> powder	5% substitution
2	<i>M. oleifera</i> powder	10% substitution
3	<i>M. oleifera</i> powder	15% substitution
4	<i>M. oleifera</i> powder	20% substitution
5	Without <i>M. oleifera</i>	No substitution 100% soy

feeders, a waterer and a droppings collection device. The droppings were collected by cage and weighed every morning. The feed distributed per cage and the refusal per cage (24 h after distribution) was weighed daily. The dry matter (MS) contents of the feed distributed and rejected as well as that of the droppings emitted were determined by evaporation at 70°C for 24 h. The Apparent Digestive Utilization Coefficient (CUDa) of dry matter (DM) was calculated by the following formula: $CUDa = (I-F)/I \times 100$ with I : amount of dry matter ingested and F : amount of dry matter from the manure emitted. For the digestibility test, four treatments without repetition were applied:

- (i) Batch 1: the chicks received 5% substitution of soybean meal by *M. oleifera* powder.
- (ii) Batch 2: the chicks received 10% substitution of soybean meal by *M.oleifera* powder.

(iii) Batch 3: the chicks received 15% substitution of soybean meal by *M. oleifera* powder.

(iv) Batch 4: the chicks received 20% substitution of soybean meal by *M. oleifera* powder.

(v) Batch 5: the chicks did not receive *M. oleifera* powder

To determine the dry matter of each batch of feed, we sampled 150 g of each batch then dried in an oven at 70°C for 24 h; The droppings are weighed before and after drying in the oven at 70°C for 24 h using a Weiheng® precision balance with a capacity of 7 kg, d = 1 g

Statistical analysis

Data on growth parameters and digestibility were subjected to a

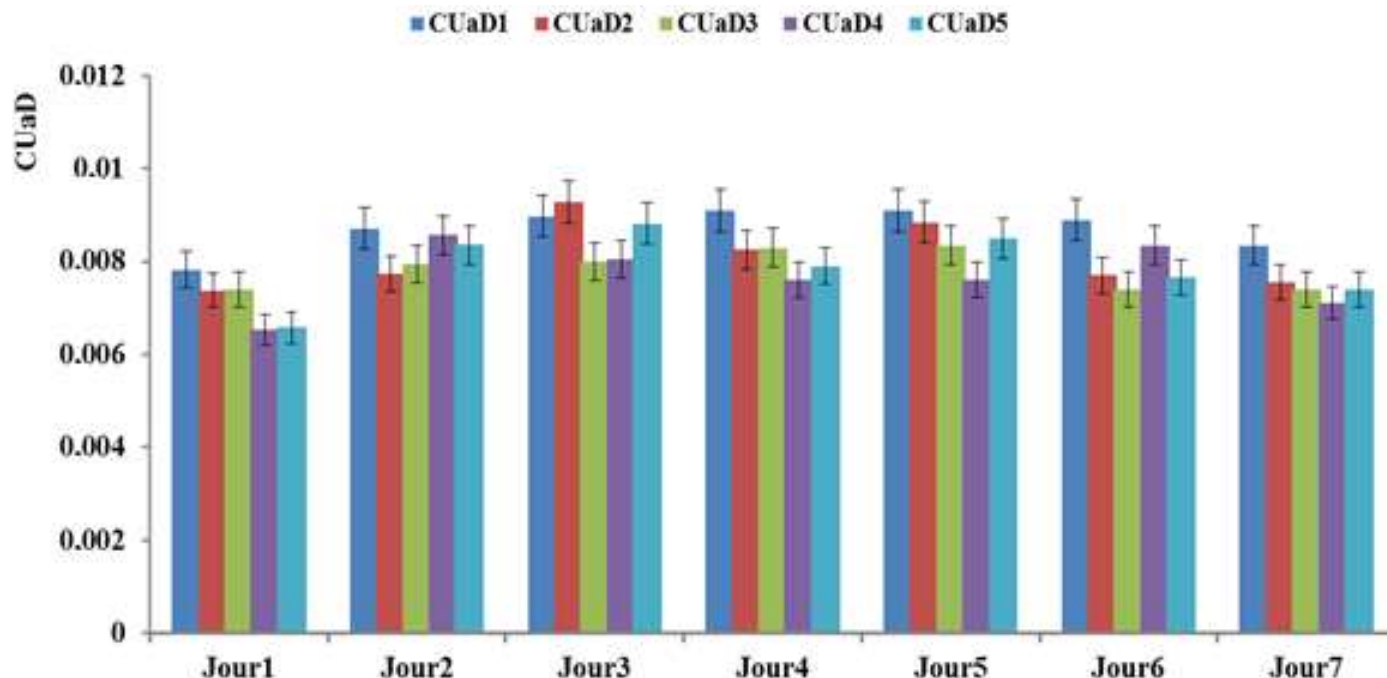


Figure 1. Diagram of the apparent digestibility utilization coefficient. CUaD1: Apparent digestibility utilization coefficient of Batch 1; CUaD 2: Apparent digestibility utilization coefficient of batch 2; CUaD 3: Apparent digestibility utilization coefficient of Batch 3, CUaD 4: Apparent digestibility utilization coefficient of batch 4; CUaD 5: Apparent digestibility utilization coefficient of Batch 5.

one-way analysis of variance (ANOVA). In case of a difference between the treatments at 5% probability, the means were separated using the Student (t) test. The R software was used for the analyses. The statistical model used was as follows:

N= number
ES= Error Standard
X= average

RESULTS

In general, the level of incorporation of *M. oleifera* flour into the ration significantly affected all production parameters. Figure 1 shows the diagram of the apparent digestibility utilization coefficient. From Figure 1, it is noted that the amount of dry matter ingested was 125.28 ± 18.78 g.MS for chickens in Batch 1 that received 5% substitution for *M. oleifera* powder; 130.57 ± 17.84 g.MS for chickens in Batch 2 that received 10% of *M. oleifera*; 146.57 ± 23.25 g.MS for Batch 3 (15% of *M. oleifera*); 165.57 ± 29.53 g. MS for Batch4 (20% of *M. oleifera*) 154.22 ± 16.25 g.MS for batch5 (100% Soybean). The amount droppings produced was 59.14 ± 17.59 g.MS (Batch 1); 50.0 ± 9.18 g.MS (Batch 2); 50.42 ± 16.11 g.MS (Batch 3); 43.28 ± 10.57 g. MS for Batch 4 and 49.41 ± 11.24 g.MS (Batch 5). Statistical analyses did not reveal a significant difference for these different parameters regardless of the batch ($p > 0.05$).

Weight gain, average daily gain (ADG) and feed conversion ratio (FCR) in ISA Brown pullets fed with *M. oleifera* powder

Feed consumption in chickens from the different experimental batches showed no significant variation between the experimental batches. Weight gain is the amount of meat deposited by a chicken after ingesting a certain amount of feed. For the different experimental batches, there was a significant increase ($p < 0.05$) in weight gain at the first and second week as the amount of *M. oleifera* incorporated into the feed increases. During weeks 1, 2 and 3, there was no significant variation between the weight gains recorded. In addition, the data recorded in the various batches showed significant variations at the 5% threshold from the 4th to the 8th week. Finally, the incorporation of *M. oleifera* powder improves weight gain until the 7th week of chicken production (Table 3).

As regards the average daily gain, large significant variations ($p < 0.05$) were recorded in chickens from the different batches during weeks 1, 2, 4, 5, 6, 7 and 8. With the exception of the second and eighth weeks where there was no significant difference in any batch. The highest average daily gains were recorded in chickens in batches 3 and 4 fed a feed containing 15% and 20% *M. oleifera* respectively (Table 4).

During weeks 4, 5, 6, and 7, the feed conversion ratio

Table 3. Weight gain (GP in g).

Weeks	BATCH 1		BATCH 2		BATCH 3		BATCH 4		BATCH 5		ANOVA
	Average	ES	Average	ES	Average	ES	Average	ES	Average	ES	
1	57.35 ^{ab}	1.45994	59.06 ^a	1.41747	59.90 ^a	1.3626	57.96 ^{ab}	1.11365	55.16 ^b	1.3116	*
2	96.49 ^b	2.99619	102.3 ^{ab}	2.58167	105.46 ^a	2.9463	100.4 ^{ab}	2.66726	104.8 ^{ab}	0.0381	*
3	154.8 ^{ab}	0	167.2 ^a	4.51949	166.1 ^a	5.0245	162.3 ^a	6.18968	152.9 ^b	3.7996	*
4	217.3 ^{ab}	0	226.5 ^a	7.46703	235.7 ^a	7.7809	222 ^{ab}	7.63522	210.7 ^b	6.0246	**
5	287.2 ^a	8.04892	291.8 ^a	9.08867	292.5 ^a	10.265	284.5 ^a	10.4381	254.8 ^b	7.6393	**
6	353 ^a	12.4335	375 ^a	11.5713	379 ^a	12.722	336.9 ^b	14.6059	317.6 ^b	8.995	***
7	437 ^b	11.2688	438 ^b	11.0951	490.3 ^a	19.275	428.7 ^{bc}	19.5815	409 ^c	12.392	***
8	523.4 ^b	15.1304	513.3 ^b	10.7024	583.2 ^a	22.722	539.4 ^b	21.063	464.2 ^c	13.464	***

NS: Not significant; ANOVA: Analysis of Variance; ES: Error Standard; *: Significant difference at 5% threshold; **: Significant difference at 1% threshold; ***: Significant difference at 1% threshold. The averages assigned to different letters (a, b) are significantly different at the 5% threshold.

(FCR) varied significantly. Chickens fed with a feed containing *M. oleifera* powder had the lowest feed conversion ratio between different batches. For the other weeks, no significant differences were observed between the different batches. During weeks 1, 2, 3, and 8, the lowest feed consumption indices were observed in chickens in the control batch (Figure 2).

DISCUSSION

Apparent digestibility of the dry matter of ISA Brown pullets fed with *M. oleifera* powder

The results obtained for the apparent digestibility test indicate that chickens fed feed containing different proportions of *M. oleifera* powder have presented a different digestibility compared to the control batch. This suggests that the different incorporation rates of *M. oleifera* powder have significantly influenced the apparent digestibility of dry matter in pullets. However, chickens that received 15% *M. oleifera* had a slightly higher digestibility than the batch that received 20% *M.*

oleifera. This is related to the incorporation of *M. oleifera* into the feed. Indeed, *M. oleifera* has properties that facilitate digestibility (Fuglie, 2001). These authors explain that the antioxidant properties of *M. oleifera* leaves are mainly due to the reducing power of β -carotene, Diphenyl-1-picrylhydrazyl (DPPH)/superoxide/hydroxyl trapping, ferrous ion chelation and lipid peroxidation. This may therefore explain the results obtained for digestibility.

Weight gain, average daily gain, feed conversion ratio of ISA Brown pullets fed with *Moringa oleifera* powder

Weight gain

The weight gains of chickens in batches that ingested the feed containing *M. oleifera* powder are greater than those in the control batch at weeks 1, 3, 4, 5, 6, 7 and 8. In addition, chickens that received 15% *M. oleifera* showed a strictly higher weight gain than chickens in the batches that received 20, 10 and 5% *M. oleifera*

respectively. This difference is related to the incorporation of *M. oleifera* into the feed.

Average daily gain

The large variations in experimental batch chickens for mean daily gain (ADG) during weeks 1, 2, 4, 5, 6, 7, and 8 are due to the antioxidant properties of *M. oleifera* (Charoensin, 2014). Apart from week 3 when the ADG is high in the control batch chickens, the highest daily average gains were recorded in chickens in batches 3 and 4 that were fed a feed containing 15 and 20% of the *M. oleifera* powder respectively, which corroborates the antioxidant property of *M. oleifera*. This confirms the results of Kakengi et al. (2007) in Tanzania on laying hens that the performance obtained with *M. oleifera* leaves is among the best compared to other leaves.

Feed conversion ratio

During weeks 4, 5, 6 and 7, the feed conversion

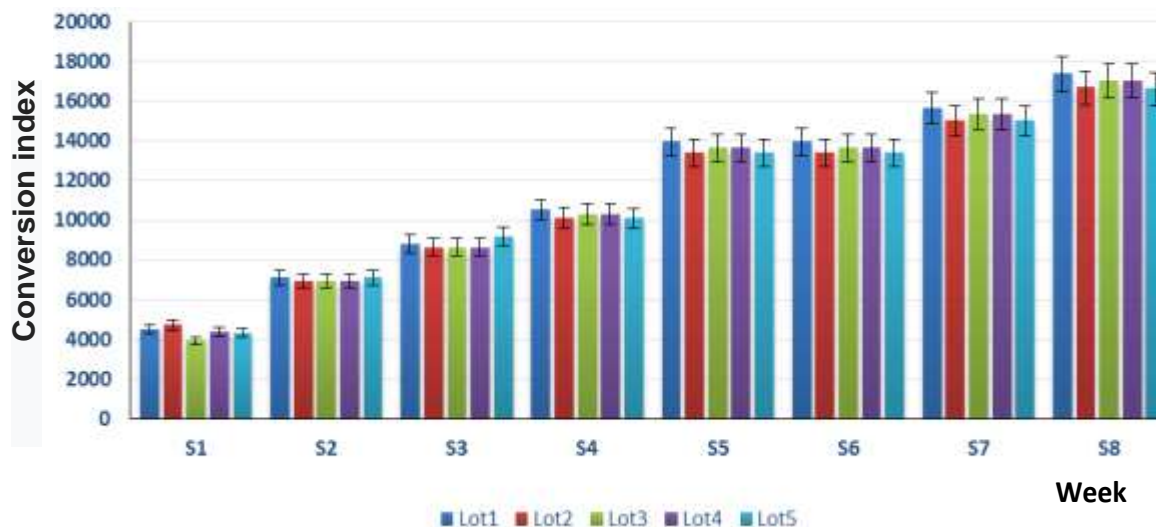


Figure 2. Evolution of the feed conversion ratio for pullets. Batch 1: Chicks received 5% substitution of soybean meal by *M. oleifera* powder; Batch 2: Chicks received 10% substitution of soybean meal by *M. oleifera* powder; Batch 3: Chicks received 15% substitution of soybean meal by *M. oleifera* powder; Batch 4: Chicks received 5% substitution of soybean meal by *M. oleifera* powder; Batch 5: Chicks did not receive *M. oleifera* powder.

ratio (FCR) varied significantly between the different batches. Chickens fed a feed containing *M. oleifera* powder had the lowest consumption indices. This confirms the results of Leclercq and Beaumont (2000) who concluded that as the protein content of the feed increases, the feed conversion ratio decreases while weight gain increases. It is the feed conversion ratio that reflects the consumption of the feed during the breeding cycle, as Jaovelo (2007) pointed out. This justifies our results because feeds containing *M. oleifera* powder are also rich in protein as the standard feed. Ndong *et al* (2007) pointed out that *M. oleifera* is rich in protein. The different FCRs obtained are much lower than those obtained by Jaovelo (2007) who proposes the value of 1.9 to 42 days of age; this confirms that *Moringa oleifera* powder improves the growth rate of pullets and therefore the feed conversion rate.

Average daily gain and feed conversion ratio

M. oleifera leaves are a vegetable of good nutritional quality and are part of one of the best tropical vegetables. They are an excellent source of protein with average levels ranging from 19-35% MS (Olugbemi *et al.*, 2010). These authors found that mature leaves contain less protein than young leaves because of their high fibre content, especially crude fibre ranging from 9.13-28.2% MS. These proteins contribute to the zootechnical performance of both broilers and laying hens. These nutritional properties or qualities of *M. oleifera* bring it closer to soybean meal. The leaves of this plant, which are more available and less expensive, thus offer the

possibility of its substitution at different rates (5, 10, 15 and 20%) in this study. With a relatively high content of metabolizable energy, 2273 and 2978 kcal/kg MS (Olugbemi, 2010), *M. oleifera* leaves contain a very high concentration of vitamins (A, B, C, E, etc.), minerals (iron, calcium, zinc, selenium, etc.) and are rich in β -carotene (Fuglie, 2002; Mborra *et al.*, 2004). Minerals occupy a modest share of the dry matter of *M. oleifera* leaves with contents of 0.6 to 11.42% MS. The fat content of *M. oleifera* leaves varies from 2.3 to 10% MS (Ndong *et al.*, 2007). Due to its exceptional nutritional qualities, *M. oleifera* leaves have been used in both feed and feed (Price, 2007). Many authors have focused on the use of the flour from these leaves in animal feed. A study by Tedonkeng *et al.* (2008) showed that the incorporation of up to 6% *M. oleifera* leaf flour in the finishing ration of broilers as a substitute for soybean meal had no negative effect on the ADG, consumption and feed conversion ratio. The same is true of Kaijage *et al.* (2003) and Kakengi *et al.* (2007), who, with high rates (20 and 15% respectively), found a significant improvement in productivity and feed consumption among laying hens. However, at 20% incorporation of the flour from these leaves, Kakengi *et al.* (2007) observed a depreciation of the feed conversion ratio. Indeed, total phenols, tannins, saponins and phytates detected in *M. oleifera* leaves may possibly limit their use in feed. Total phenols (0.67-3.4%) and tannins (0.5-1.4%) are known to reduce the bioavailability of proteins, carbohydrates and minerals in the intestine of animals (Tchiégang and Aissatou, 2004). Phytates (2.3 to 3.1%) and oxalates (4.1%) present in legumes at a rate of 1 to 5% reduce the bioavailability of minerals, particularly phosphorus (Richter *et al.*, 2003).

Table 4. Average Daily Gain.

Weeks	BATCH 1		BATCH 2		BATCH 3		BATCH 4		BATCH 5		ANOVA
	Average	ES	Average	ES	Average	ES	Average	ES	Average	ES	
1	3.857 ^{ab}	7.6365	3.936 ^a	7.8875	3.990 ^a	8.15789	4.029 ^a	7.8683	3.308 ^b	7.40947	**
2	6.149 ^{ab}	12.816	6.478 ^{ab}	14.022	6.509 ^a	14.4395	6.062 ^b	13.912	7.438 ^a	2.06538	*
3	9.251 ^a	20.419	9.293 ^a	23.037	9.467 ^a	22.9427	9.749 ^a	22.357	7.981 ^a	21.9654	NS
4	11.59 ^a	30.011	9.905 ^{ab}	32.048	12.29 ^a	32.8697	10.94 ^{ab}	31.038	8.931 ^b	30.4486	*
5	11.347 ^{ab}	39.995	12.130 ^{ab}	41.442	14.788 ^a	41.1172	13.26 ^a	40.42	9.439 ^b	37.2273	**
6	12.72 ^{ab}	39.995	15.313 ^a	48.586	15.5779 ^a	53.878	15.706 ^a	47.564	11.15 ^b	46.332	*
7	12.72 ^{ab}	61.629	15.31 ^a	41.442	15.579 ^a	67.6889	15.706 ^a	59.563	11.15 ^b	57.3356	*
8	17.657 ^c	72.969	12.87 ^a	69.179	23.29 ^a	72.8119	19.657 ^{ab}	73.852	15.96 ^d	65.9122	***

NS: Not significant; ANOVA: Analysis of Variance; ES: Standard Error; *: Significant difference at 5% threshold; **: Significant difference at 1% threshold; ***: Significant difference at 1% threshold. The averages assigned to different letters are significantly different at the 5% threshold.

Trypsin inhibitors have not been detected in *M. oleifera* leaves while other anti-nutritional factors are at low levels (Kavitha et al., 2012).

In short, *M. oleifera* is characterized by a high content of nutrients, antioxidants, glucosinolates, phytochemicals and organoleptic qualities. However, given the results obtained in this study, it would be better not to exceed the incorporation rate of 20% at the risk of not affecting productivity in chickens because of the inhibitory effect of the anti-nutritional factors present in the leaves of *M. oleifera*.

Conclusion

The incorporation of *M. oleifera* powder into the staple feed did not have a noticeable negative effect on the zootechnical parameters of ISA Brown laying hens, but improved growth and feed conversion ratio. In this case, *M. oleifera* leaf flour can be considered as a possible alternative in the feeding of laying hens for economic purposes. This study opens the way for prospecting medicinal

plants to strengthen the immune system, particularly in vulnerable and genetically weakened avian strains, in this case laying hens.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

- Aboh AB, Dahouda M, Adjolohoun S, Senou M, Toleba SS, Abou M, Vidjannagni DS, Kpodékon M (2002). Effets des aliments contenant des folioles de *Moringaoleifera* Lam et des aliments commerciaux sur les performances de croissances des lapins (*Oryctolagus cuniculus*). International Journal of Biological and Chemical Sciences 7(5):1838-1852.
- Charoensin S (2014). Antioxidant and anticancer activities of *Moringa oleifera* leaves. Journal of Medicinal Plants Research 8(7):318-325.
- Dougnon JT, Edoth AP, Bankole HS, Kpodékon M, Gbenou J (2011). Efficiency of ethanol extract of *Moringa oleifera* Lam. leaves for the treatment of *Staphylococcus aureus* infections in chicks. Journal of Medicinal Plants Research 5(31):6704-

6708.

- Food and Agriculture Organization (FAO) (2000). Guidelines for computing crop water requirements- FAO. Irrigation and drainage paper 56, FAO. Organisation of the United Nation, Rome (<http://www.fao.org>).
- Food and Agriculture Organization (FAO) (2010). Gopal Fishing Effort (1950-2010): Trends, Gaps, and Implication 107(1-3):131-1365.
- Fuglie LJ (2001). Introduction to the multiple uses of *Moringa* (7-10) In: Fuglie LJ (editor). The miracle tree: the multiple attributes of *Moringa*. -Wageningen: CTA; Dakar: CWS. 177 p.
- Fuglie LJ (2002). Nutrition naturelle sous les tropiques (105-118). In: L'arbre de la vie, Les multiples usages du *Moringa*.-Wageningen : CTA; Dakar: CWS. 177 p.
- INSAE (2008). Institut National de la Statistique et de l'Analyse Economique Rapport annuel d'activité 15 p
- Jaovelo FN (2007). Effet de la supplémentation en volihot sur les performances zootechniques de poulet de chair en période de stress thermique. Thèse de Médecine Vétérinaire, E.I.S.M.V. Dakar 115 p.
- Kajjage JT, Sarwatt SV, Mutayoba SK (2003). *Moringa oleifera* leaf meal canim prove quality characteristics and consume preference of marketable eggs. Un publish eddicertation for award of Msc degree in animal science at Sokoine University of Agriculture, Morogoro, Tanzania. [En ligne]. Accès Internet:URL : [www.costech.or.tz/Proceedings/Papers/Alphabetical/Moringa a%20Oleifera% 20 Leaf%20Meal%20-%20Kajjage-S...](http://www.costech.or.tz/Proceedings/Papers/Alphabetical/Moringa%20Oleifera%20Leaf%20Meal%20-%20Kajjage-S...) (page consultée le 28/09/2018)

- Kakengi AMV, Kaijage JT, Sarwatt SV, Mutayoba SK, Shem MN, Fujihara T (2007). Effect of *Moringaoleifera* leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. *Livestock Research for Rural Development* 19(8).
- Kavitha C, Ramesh M, Kumaran SS, Lakshmi SA (2012). Toxicity of moringaoleifera seed extract on some hematological and biochemical profiles in a freshwater fish, *cyprinus carpio*. *Experimental and Toxicologic Pathology* 64:681-687.
- Laurenson P (2002). Détermination des paramètres zootechniques de la pintade locale dans la région du Borgou. Mémoire pour l'obtention du diplôme d'Ingénieur : Faculté des Sciences Agronomiques de Gembloux, Université de Gembloux 81 p.
- Leclercq B, Beaumont C (2000). Etude par simulation de la réponse des troupeaux de volailles aux apports d'acides aminés et de protéines, Station de recherche avicole de l'INRA, Nouzilly (France). *INRA Production Animal* 13:47-59.
- Mbora A, Mundia G, Muasya S (2004). Combating nutrition with *Moringa oleifera*. Nairobi: World Agroforestry Centre. p. 43.
- Mufwaya PU, Kiatoko MH (2016). Effet de substitution de tourteau palmiste par le foin de *Moringa oleifera* dans la ration, sur la croissance de poulet de chair de souche ISA 715. *International Journal of Innovation and Applied Studies* 15(4):936-942.
- Ndong M, Wade S, Dossou N, Guiro AT, Gning RD (2007). Valeur nutritionnelle du *Moringa oleifera*, étude de la biodisponibilité du fer, effet de l'enrichissement de divers plats traditionnels sénégalais avec la poudre des feuilles. *African Journal of Food, Agriculture, Nutrition and Development* 7(3).
- Olugbemi TS, Mutayoba SK, Lekule FP (2010). Effect of *Moringa (Moringa oleifera)* Inclusion in Cassava Based Diets Fed to Broiler Chickens. *International Journal of Poultry Science* 9(4):363-367.
- Omole AJ (2006). Performance of snail fed graded levels of ripe and unripe pawpaw. *Proc. 26th Annual Conference of Animal Production* pp. 224-227.
- Pamok S, Saenphet S, Vinitketkumnuen U, Saenphet K (2012). Antiproliferative effect of *Moringa oleifera* Lam. and *Pseuderanthemumpalatiferum* (Nees) Radlk extracts on the colon cancer cells. *Journal of Medicinal Plants Research* 6(1):139-145.
- Price ML (2007). Le *Moringa*. In Note technique- ECHO (revue en 2000, en 2002 et en 2007). [En ligne] Accès Internet: <http://www.echonet.org/tropicalag/technotes/Moringa.pdf> (Page consultée le 14 Octobre 2018).
- Raphaël KJ, Christian KT, Juliano RS, Lisita F, Sultana MY, Hervé MK, Alexis T (2015). Effects of Substituting Soybean with *Moringa oleifera* Meal in Diets on Laying and Eggs Quality Characteristics of KABIR Chickens. *Journal of Animal Resources and Nutrition* 1(4).
- Richter N, Siddhuraju P, Becker K (2003). Evaluation of nutritional quality of *Moringa (Moringa oleifera* Lam.) leaves as an alternative protein source for Nile tilapia (*Oreochromis niloticus* L.). *Aquaculture* 217:599-611.
- Tchiégang C, Aissatou K (2004). Données ethn nutritionnelles et caractéristiques physico-chimiques des légumes-feuilles consommés dans la savane de l'Adamaoua (Cameroun). *Tropicicultura* 22(1):11-18.
- Tedonkeng PE, Niba AT, Fonteh FA, Tedonkeng F, Kana JR, Boukila B, Tsachoung J (2008). Effet de la supplémentation au *Moringa oleifera* ou aux blocs multi nutritionnels sur l'évolution du poids post-partum et la croissance pré-sevrage des cobayes (*Caviaporcellus* L.). *Livestock Research for Rural Development* 17(46).

Full Length Research Paper

Effect of nutritional flushing on reproductive and body weight performance of Abergelle goat does

Minister Birhanie^{1*}, Mulalem Zenebe² and Hailai Hagos³

¹Livestock Production, Tigray Agricultural Research Institute, Mekelle Center, Ethiopia.

²Livestock Production, Tigray Agricultural Research Institute, Shire-Maytsebri Center, Ethiopia

³Livestock Production, Tigray Agricultural Research Institute, Abergelle Center, Ethiopia

Received 29 March, 2020; Accepted 19 May, 2020

This study was aimed to evaluate the effect of flushing on the reproductive and body weight change on Abergelle breed does. The study indicated that a mix of 300 or 450 g wheat bran (WB) with 50 g noug seed cake (NSC) flushed per day improved the does' conception rate (70 to 80%) and kidding rate (70%); while does flushed with low concentrate level (150 g WB plus 50 g NSC) or those not flushed had poor and reduced conception and kidding rate almost by half from the flushed ones. However, the high concentrate level is not strategic to reduce abortion rate. Does flushed with high concentrate level (300 and 450 g WB mix with 50 g NSC) were significantly ($p < 0.05$) better in body weight at kidding (18.52 kg) and postpartum weight (19.48 kg) than does flushed with low concentrate level (16.44 and 17.70 kg, respectively). As the concentrate levels supplementation of their dam increased, birth weight of kids increased (1.73 to 2.36 kg). Therefore, the conception rate, postpartum weight, kid production of Abergelle goat can improve by flushing with 300 g WB and 50 g NSC concentrated feed. However, its effect on the reduction of abortion rate is not promising. Further study is needed on the abortion problem.

Key words: Abortion rate, birth weight, body weight, conception rate, concentrated feed, goat, kidding rate, supplementation.

INTRODUCTION

Reproduction in goat is seasonal which is mainly influenced by photoperiod. Comparing to temperate, tropical goat breeds are continuous breeders, can ovulate every month throughout the year due to less day length change in the area. However, forage unavailability and temperature change have strong influence to fully express their potential (Fatet et al., 2011). Seasonal feed availability and quality is a major constraint to biological productivity of small ruminants in the tropics (Berhane and Eik, 2006; Ben Salem and Smith, 2008). As a result, the huge resources of goats, estimated to be 32.74

million in Ethiopia (CSA, 2018), have not fully benefited the small holder farmers as well as the country in economy and food security. Feed scarcity in quantity and quality is a major factor for the reduced goat productivity in Ethiopia. Cattle, sheep and goat often depend on poor quality feeds of pasture (56%) and crop residues (30%) (FAO, 2019).

In addition, feed resources of grazing pasture are reduced due to overgrazing and expanding crop production (Ben Salem and Smith, 2008). The number of establishments in the food establishments in the food and

*Corresponding author. E-mail: msmini2001@gmail.com.

and beverages factories is increasing (CSA, 2017). Wheat bran and noug seed (*Guizotia abyssinica*) cake industry byproducts are widely used as animal feed in the country. These byproducts are less fibrous and rich in energy and/or protein with high digestibility. Wheat bran has 151 g CP and 460 g NDF per kg DM. Whereas, noug seed (*G. abyssinica*) cake has 353 g CP and 339 g NDF per kg DM (Tesfay and Tesfay, 2013)

Rekik et al. (2007) indicated that short, medium and long dietary changes can modify the reproductive traits of goat. Animal production in tropics is dependent on supplemental feeding as supply of energy and protein for reproduction, but these feeds can contain compounds that affect various components of reproductive cycle (Blache et al., 2008). Responses to flushing, however, are often variable and inconsistent depending on factors such as genotypes (Chemineau et al., 2004), body conditions of the animals (O'Callaghan et al., 2000), timing and duration of flushing (Sabra and Hassan, 2008; Karikari and Blasu, 2009), the amount and quality of dietary supplements (Acero-Camelo et al., 2015).

In the study area, keeping of goats with low fertility rate which have long kidding interval (Belay et al., 2014) and high abortion rate (Abay et al., 2017) are major problem of Abergelle goat in smallholder farmers. Therefore, this research aimed to evaluate the effect of energy and protein mix concentrated feed supplement prior and during breeding time in reproduction and production performance of Abergelle goats.

MATERIALS AND METHODS

Experimental site

The study was conducted at the goat breed evaluation and improvement farm of Abergelle agricultural Research Center in Tanqua-Abergelle district, central zone of Tigray, Northern Ethiopia. The latitude, longitude and altitude at the goat farm are 13° 22' N, 38° 99' E and 1574 m above sea level, respectively. The area is categorized as hot to warm sub-moist lowland (SM1-4) sub-agroecological zone of the region with an altitude of 1300-1500 m above sea level and the mean annual rain fall ranging from 400 to 600 mm which is characterized by low, erratic and variable rainfall. The mean annual temperature ranges from 28 to 42°C (WOARD, 2011).

Animal type and feeding management

The experiment was undertaken on a station goat farm which has semi intensive production system using wheat bran and noug seed (*G. abyssinica*) cake feeds as flushing feeds for one to two years old Abergelle breed goat does. Their age was estimated using FAO (2011) guide of goat age estimation from dentation. Basal diet of the does was hay, and free grazing and browsing in the pasture of fenced farm. Half of the flushing feeds were given in the morning and half in the evening, individually. All experimental goats were drenched with a broad spectrum anthelmintic, sprayed with an acaricide and vaccinated against major diseases (sheep and goat pox and ovine pasteurellosis). Flushing period was nine weeks, three weeks before joined buck and continued for six weeks during

breeding period or joining bucks in the breeding season to have a second chance of oestrus cycle and mating.

Experimental design and sampling methods

The experimental animals were twenty Abergelle goat does which had grade three (scale of 0 to 5) body conditions score. The sample was selected randomly using randomized complete block design with five replications and four treatments. The treatments were:

- T1. *Ad Libitum* hay
- T2. *Ad libitum* hay + 150 g wheat bran + 50 g noug seed (*G. abyssinica*) cake per day
- T3. *Ad libitum* hay + 300 g wheat bran + 50 g noug seed (*G. abyssinica*) cake per day
- T4. *Ad libitum* hay + 450 g wheat bran + 50 g noug seed (*G. abyssinica*) cake per day.

Data to be collected

All the experimental does were tagged with an identification ear tag. Data on initial weight, weight prior to breeding, mating date, abortion, kidding date, litter size, birth weight of kids, monthly postpartum weight for three months, health status and death were recorded.

Data analysis

The collected data were analyzed using reproductive rates calculation (conception rate, kidding rate and abortion rate listed below) and SAS version 9 Analysis of variance, carried out by SAS, version 9, was used to statistically test the effect of treatments upon the body weight changes of does and kids' birth weight. When ANOVA detected significant differences within treatments, the post-hoc Dunnett test was applied to perform multiple comparisons. The reproductive performances were calculated as follow:

$$\text{Conception rate} = \frac{\text{number of does conceived}}{\text{number of does joined to bucks}}$$

$$\text{Kidding rate} = \frac{\text{number of kids born alive}}{\text{number of does joined to bucks}}$$

$$\text{Abortion rate} = \frac{\text{number of does aborted}}{\text{number of does joined to bucks}}$$

RESULTS AND DISCUSSION

Effect of flushing on reproductive traits of Abergelle goat dams

The treatments of the current study were categorized as high (T4 and T3) and low concentrate level (T2 and T1) because of similar results in each category. The does flushed with 450 g and 300 g wheat bran mixing with 50 g noug seed (*G. abyssinica*) cake per day had showed high conception rate (70 to 80%) and kidding rate (70%) (Table 1). This high-level of flushing concentrated feed induced energy to mate and conceive higher than of those does flushed with low level of concentrated feed

Table 1. Effect of flushing on conception, abortion and kidding rate of Abergelle does.

Studied trait	High concentrate level (HCL)		Low concentrate level (LCL)	
	T4 (%)	T3 (%)	T2 (%)	T1 (%)
Conception rate	70	80	54	57
Abortion rate	0	10	11	11
kidding rate	70	70	43	46

T4= *Ad libitum* hay + 450 g wheat bran + 50 g noug seed (*G. abyssinica*) cake T3= *Ad libitum* hay + 300 g wheat bran + 50 g noug seed (*G. abyssinica*) cake, T2= *Ad libitum* hay + 150 g wheat bran + 50 g noug seed (*G. abyssinica*) cake, T1= *Ad libitum* hay.

Table 2. Live body weight change of experimental does.

Parameter	Initial weight	Prior to breeding weight	Kidding weight	Post-partum weight	Kids' birth weight
	Mean	Mean	Mean	Mean	mean
HCL (kg)	14.83	15.72	18.52	19.48	2.36
LCL (kg)	14.89	15.73	16.44	17.07	1.73
SEM	0.26	0.46	0.41	0.4	0.15
<i>P</i>	0.913	0.988	0.008	0.002	0.04

HCL=high concentrate level (T3 and T4), LCL= low concentrate level (T1 and T2).

and none supplemented. However, flushing with high level concentrate supplementation is not effective to reduce abortion. An experiment in ewes in India confirmed that the community rangeland in semi-arid area of the country is low in feed biomass and insufficient to meet nutrient requirement for reproduction. Higher lambing (79.2%) and conception (73.7%) rates were recorded by flushing with 1.5% concentrate feed of their body weight in the mating season as compared to none flushed ewes (Chaturvedi et al., 2006). In the other way, flushing with 153 g/day CP and 2.19 Mcal/kg metabolized energy improved both the sexual receptivity and the reproductive performance of sheep (Fazel et al., 2014). Energy and protein sources feed supplementation (27 to 30% CP) for the short period of time has improved the reproductive efficiency of Spanish and their crossbred with Boer does under poor body condition (Melesse et al., 2013).

Effect of flushing on body weight change

Table 2 indicates an increment of live body weight of experimental does. High level concentrated feed supplemented does were significantly heavier in kidding (18.52 kg) and postpartum average weight (19.48 kg) than does supplemented with low level of concentrated feed (16.44 kg) in kidding and 17.70 kg at postpartum (Table 2). 3-4 years old WAD does may benefit from concentrate supplementation (420 g DM/d with 231 g/kg CP) than 5-6 years old WAD does of moderate body condition (Karikari and Blasu, 2009).

Birth weight of kids increased as concentrated feed level for does supplementation increased. The mean values of kids' birth weight from does flushed with high concentration level of feed were 2.36 kg, while the kids born from the does supplemented with low concentrate level were 1.73 kg.

CONCLUSION AND RECOMMENDATION

Supplementation of mixed concentrate feeds of 300 g wheat bran with 50 g noug seed (*G. abyssinica*) cake as flushing in the breeding season is effectively improved the conception rate and kidding rate of Abergelle does whereas flushing with low level of concentrate could not improve reproductive performances of the does. In addition, flushing with higher than 300 g of wheat bran plus 50 g noug seed cake per day per doe has not improved the reproductive performance of Abergelle does.. However, flushing of Abergelle does with high (>300 g) level of wheat bran with 50 g noug seed cake per day per doe is important for dam to stay in good body condition (weight) for the next breeding and have heavier kids as well. This study indicates that the abortion problem is not reduced using this flushing experiment protocol, therefore further study is needed to prevent abortion in Abergelle does.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

- Abay G, Zenebe M, Desta D, Hagos H, Berhanie M, Teame T (2017). Clinical survey on major ruminant diseases in Kola Tembein and Tanqua Abergelle Districts, Central Zone of Tigray, Northern Ethiopia. *Journal of Veterinary Medicine and Animal Health* 9(12):342-348.
- Acero-Camelo A, Valencia E, Rodríguez A, Randel PF (2015). Effects of flushing with two energy levels on goat reproductive performance. *Livestock Research for Rural Development* 20(9).
- Belay S, Gebru G, Godifey G, Brhane M, Zenebe M, Hagos H, Team T (2014). Reproductive performance of Abergelle goats their crosses. *Livestock Research for Rural Development* 26(1):1-5.
- Ben Salem H, Smith T (2008). Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Research* 77(2-3):174-194.
- Berhane G, Eik LO (2006). Effect of vetch (*Vicia sativa*) hay supplementation to Begait and Abergelle goats in northern Ethiopia II Reproduction and growth rate. *Small Ruminant Research* 64(2006):233-240.
- Blache D, Maloney SK, Revell DK (2008). Use and limitations of alternative feed resources to sustain and improve reproductive performance in sheep and goats. *Animal Feed Science and Technology* 147(2008):140-157.
- Chaturvedi OH, Bhatta R, Verma DL, Singh NP (2006). Effect of Flushing on Nutrient Utilization and Reproductive Performance of Ewes Grazing on Community Rangeland. *Asian-Australasian Journal of Animal Sciences* 19(4):521-525.
- Chemineau P, Daveau A, Cognié Y, Aumont G, Chesneau D (2004). Seasonal ovulatory activity exists in tropical Creole female goats and Black Belly ewes subjected to a temperate photoperiod. *BMC Physiology* 4(11):1-11.
- CSA (2017). Report on Livestock and Livestock Characteristics (Private Peasant Holdings). Federal Democratic Republic of Ethiopia (Vol. II). Addis Ababa. Retrieved from http://www.who.int/entity/countryfocus/cooperation_strategy/ccsbrief_eth_09_en.pdf
- CSA (2018). Agricultural Sample Survey. Report on Livestock and Livestock Characteristics (Private Peasant Holdings). Federal Democratic Republic of Ethiopia (Vol. II) Addis Ababa.
- FAO (2011). Draft guidelines on phenotypic characterization of animal genetic resources, (April), 92.
- FAO (2019). Ethiopia. Availability and utilization of agroindustrial by-products as animal feed 2018. Rome. Retrieved from <https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode/legalcode>
- Fatet A, Pellicer-Rubio MT, Leboeuf B (2011). Reproductive cycle of goats. *Animal Reproduction Science* 124(3-4):211-219.
- Fazel AA, Daghigh H, Fazel A, Adv IJ, Biom B. (2014). Effect of Flushing Ration on the Sexual and Breeding Behaviors in Ghezel Sheep. *International Journal of Advanced Biological and Biomedical Research* 2(5):1700-1706.
- Karikari PK, Blasu EY (2009). Influence of nutritional flushing prior to mating on the performance of West African Dwarf goats mated in the rainy season. *Pakistan Journal of Nutrition* 8(7):1068-1073.
- Melesse A, Abebe G, Merkel R, Goetsch A, Dawson L, Gipson T, Tilahun S (2013). Effect of Body Condition Score and Nutritional Flushing on the Reproductive Performances of Spanish and Spanish x Boer Crossbred Does. *Ethiopian Journal of Agricultural Science* 153:141-153.
- O'Callaghan D, Yaakub H, Hyttel P, Spicer LJ, Boland MP (2000). Effect of nutrition and superovulation on oocyte morphology, follicular fluid composition and systemic hormone concentrations in ewes. *Journal of Reproduction and Fertility* 118(2):303-313.
- Rekik M, Lassoued N, Salem HB Mahouachi M (2007). Interactions between nutrition and reproduction in sheep and goats with particular reference to the use of alternative feed sources. *Options Méditerranéennes* 74:375-383.
- Sabra HA, Hassan SG (2008). Effect of New Regime of Nutritional Flushing on Reproduction Performance of Egyptian Barki Ewes. *Global Veterinaria* 2(1):28-31.
- Tesfay T, Tesfay Y (2013). Partial replacement of dried *Leucaena leucocephala* (Lam .) de Wit leaves for noug (*Guizotia abyssinica*) (L . f .) Cass . seed cake in the diet of highland sheep fed on wheat straw. *Tropical Animal Health and Production* 45:379-385.
- WOARD (2011). Woreda Office of Agriculture and Rural Development. Annual report tanqua abergele district.

Full Length Research Paper

The last of us? An online survey among German farm veterinarians about the future of veterinary training, livestock farming and the profession in general

Christian Dürnberger

Messerli Research Institute, Austria.

Received 31 March, 2020; Accepted 19 May, 2020

This online survey investigated how German farm veterinarians perceive the future of their profession. According to the participants, the following topics should play a greater role in veterinary training: Economics, herd health management, practical education, agricultural knowledge and animal welfare issues. The top answer indicates that knowledge about entrepreneurship is seen as a crucial competence of veterinarians. In regard to urgently needed changes in livestock farming, the participants recommend a general economic restructuring, a more fact-based public and political debate, an improved control system, improved training of farmers with a focus on animal welfare and a general critical questioning of performance optimisation. While the common literature focuses on reasons for distress, the survey identified factors for job *satisfaction*: German farm veterinarians recommend their job because of the variety of veterinary work, the contact with animal owners, the contact with animals, economic security, the importance of the work because it is about producing food and the possibility to work outdoors. At the same time, the survey identified a general dark mood when it comes to the future of the profession and livestock farming in general. Veterinarians see themselves as part of a world that is in decline.

Key words: Online survey, German farm veterinarians, veterinary ethics, food production, veterinary curriculum, animal welfare, veterinary education.

INTRODUCTION

Livestock farming is an important element of the human food industry. However, today's western societies - Germany can be mentioned as a typical example, have an ambivalent relationship with current animal husbandry (Boogard et al. 2011). While people appreciate low food prices and increased food safety (Boogard et al., 2008), they are increasingly concerned about animal welfare issues (Krystallis et al., 2009; Kayser and Spiller, 2012;

Busch et al., 2015; Clark et al., 2016; Bergstra et al., 2017; Special Eurobarometer, 2018). For example, confronted with images of common practices in current livestock farming, large parts of the German society assess them as extremely negative (Boehm et al., 2010; Weible et al., 2016). The Scientific Advisory Board for Agricultural Policy at the German Federal Ministry of Food and Agriculture (WBA) sees a general sharply

E-mail: christian.duernberger@vetmeduni.ac.at.

Author(s) agree that this article remain permanently open access under the terms of the [Creative Commons Attribution License 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

decreasing social acceptance of livestock farming in its well-received report on the future of German livestock husbandry (WBA, 2015). As a reaction to this loss of acceptance, the Federal Ministry of Food and Agriculture presented its “livestock husbandry strategy” in 2017 (BMEL, 2017). Some voices even call for the abolition of livestock farming: in the tradition of Regan (1983), who argued that non-human animals have specific moral rights because they have to be understood as “subjects-of-a-life”, current German animal ethicists like Schmitz (2016) and also NGOs oppose livestock farming per se, arguing that animals should *not* be kept for food production.

Against this background, the profession of farm veterinarians becomes even more challenging: they do not only have to weigh up the interests of animal patients, animal owners and society as a whole (Tannenbaum, 1993; Rollin, 2006; Morgan and McDonald, 2007; Magalhães-Sant’Ana and Hanlon, 2016; Mullan and Fawcett, 2017), but the corresponding difficult decisions are taken against the backdrop of the described social controversy.

However, while societal perceptions of animal husbandry are often analysed, there are, for example, studies on how certain practices and images of animal husbandry affect German citizens and consumers and what expectations and wishes they have (Christoph-Schulz et al., 2019; Gier et al., 2018; Groß and Roosen, 2018; Grunert et al., 2018; Roosen et al., 2018; Rovers et al., 2018; Sonntag and Spiller, 2018; Rovers et al., 2017). There is little literature on how veterinarians themselves perceive livestock farming in general and the future of their profession in particular. The understanding of their perspectives is largely anecdotal. This research gap was the starting point of this paper: the study aimed at a better understanding of how German farm veterinarians perceive their profession in the described social context. In order to increase this understanding, three initial research questions were asked: (a) From the farm veterinarians’ point of view, which topics and issues should play a greater role in veterinary medicine studies in order to prepare students more adequately for their future job? The answers should show basic self-understandings: What does it take - beyond veterinary expertise - to get the job done in a successful way? (b) As discussed, there is a social controversy about livestock farming. Citizens, consumers, supermarket chains and politics make demands. However, what do the farm veterinarians themselves want? In their view, what should urgently be changed in livestock farming? (c) Finally, would farm veterinarians choose the profession again? Would they currently advise students to choose this profession? And what advice would they give to students who want to become farm veterinarians? These three questions were intended to describe a general atmospheric picture: How do farm veterinarians perceive the future of their profession?

The study is based on a broad understanding of descriptive ethics. While normative works try to provide a justified answer to the question of how to act from a moral perspective (Düwell 2008, 36), descriptive ethics strive for a better understanding of a moral challenge, describing it not only in its ethical framework but also in its historical and cultural tradition (Fischer, 2001; Lesch, 2006). That means, if we want to adequately understand the moral challenges of a profession, we first have to understand its life world.

METHODS

The survey targeted veterinarians who are working (fully or partially) in the livestock sector in Germany. Google was used to identify veterinarians or veterinary practices in the livestock sector in Germany. This research was considered finished after having found around 200 contacts (more precisely: 227). Since the focus of the study is qualitative, this number seemed to be appropriate in order to get enough material for the analysis. These 227 contacts were invited by e-mail to take part in the online survey on www.umfrageonline.com. Furthermore, “MSD Tiergesundheit”, the newspaper “Der HofTierarzt” as well as the Federal Association of Practising Veterinarians (“Bundesverband Praktizierender Tierärzte e.V.”) referred to the online survey. Participation in the study was voluntary and anonymous. No incentive was offered. The participants were informed that the results would be published. The questionnaire was available online between 1 June and 30 September, 2019. The first version of the survey was field-tested in a small group with a special focus on comprehensibility and clarity of the questions. The feedback of this evaluation was integrated into the final version.

The decision to carry out an online survey was taken for pragmatic reasons: potential participants live all over Germany and have tight schedules, making it difficult to invite them to semi-structured interviews or to visit them. An online survey gave them the opportunity to be flexible in terms of time and place to answer the questions. The questionnaire consisted of three parts designed to collect data on the following: (a) demographic data (8 items: gender, age, working in which federal state, with which animals and since when, self-employed or employed, studied at which university and when did the studies end); (b) Moral challenges (2 open and 12 closed questions; see an upcoming publication); (c) Future of veterinary medicine in the context of livestock farming (6 open and 6 closed questions; see below). The results presented in this paper focus on part (c).

The closed questions presented statements requiring respondents to indicate the extent of their agreement or disagreement on a 6-point Likert scale. The given statements were developed on the basis of ethics workshops with veterinarians. The answers to the open questions in the study were evaluated according to the method of qualitative content analysis, following Mayring (2015) and Kuckartz (2012, 78): (a) an initial round of work on the texts, in which important passages are marked, is followed by (b) the preparation of a first draft setting out a system of main categories. The first test run checks the general adequacy of this system. (c) The material is coded to reflect the categories. (d) All text passages coded with the same category are compiled. (e) Working directly on the raw material, subcategories (if appropriate) are obtained inductively, and further tests are conducted to check and refine the system of main categories and subcategories. Finally, (f) the material as a whole is coded, using the differentiated system. At this point, (g) the discussion of the results can begin. In regard to the open questions, the current survey followed these to a

Table 1. Teaching contents of growing importance.

Question: "Which topics and questions should play an increasing role in veterinary studies in order to adequately prepare farm veterinarians for their job?" (n=72)	1) Economics (n=32)	2) Herd health management (n=25)	3) More practical training (n=21)
	4) Agricultural knowledge (n=16)	5) Animal welfare (n=13)	6) Communication (n=11)
	7) Law (n=10)	8) How to run a practice (n=9)	9) Psychology (n=7)

steps. The answers to the open questions were also evaluated quantitatively. However, since specific answers can often only be limitedly assigned to a certain category, such information only gives an approximate impression of the quantitative distribution. The survey was conducted in German. When veterinarians are quoted in the text below, these statements were translated from German into English.

RESULTS

Demographic data

A total of 123 participants took part in the study (thereof approximately 51% female). The average age of the participants was 45.39 years. On average, the participants have been working as farm veterinarians for 16.39 years. Multiple selections were possible for the specific field of activity: most of the participants (approximately 92%) stated that they worked in the field of cattle farming; 33% stated that they worked with pigs. About 50% of the participants stated that they were self-employed with salaried employees; about 35% stated that they were employed and about 13% that they were self-employed without salaried employees. 89% of the participants studied at German universities. The participants are working in twelve different German federal states. The "front runner" is Bavaria with 33%, followed by Lower Saxony with 20% and Nordrhein-Westfalen with 13.9%. No significant differences were observed between demographic data and the answers are presented below.

Teaching contents of growing importance

In an open question, the participants were asked which topics should play a greater role in veterinary studies to adequately prepare students for being a farm veterinarian (n=72). The nine most frequently mentioned answers are discussed next (also shown in Table 1):

(a) Economics

The most common answer can be subsumed under the category *economics* (n=32). There is a need for "business management training"; "business management topics" should be taught more often and more intensely. Expertise about "business management" is required: "Only those who have basic knowledge are at all times

able to take over and manage a practice without losing a lot of money." "Basic economic knowledge" should therefore promote "economic efficiency in veterinary practice".

(b) Herd health management

In their answers to this question, participants repeatedly raised the issue of *herd health management* (in German: *Bestandsbetreuung*) (n=25). There should be a "greater focus on herd health management" in veterinary training. The veterinary competencies taught at university should "not be limited to curing diseases but should focus on fighting the root causes". One issue that was frequently mentioned and can be subsumed here is "feeding". For example: "Practical animal nutrition (not just tables and figures!) and its effects on the animals" should be taught.

(c) More practical training

In general, study participants demand *more practical training* (n=21): "Overall [a] better professional practical preparation" is needed. "Topics and questions are theory. Much more practical training/internships should be carried out in the course of the studies, similar to those in human medicine." Students should "learn many more practical skills" and have "more practical training on animals and at farms". Correspondingly, more "internships" and "altogether more practical training" are repeatedly called for because "there is a huge difference between university and practice!" "Since these topics and questions can hardly be clarified in a lecture, more internships should be done and enough time for them should be made available." According to one participant, more practical training also means that "treatment options at different levels" should be taught, that is "not only the 'gold standard', but also cost-effective alternatives".

(d) Agricultural knowledge

General *agricultural knowledge* should play a greater role in veterinary medicine studies (n=16). Here, too, the topic "economics" is important: students should be able to understand the "economics of agriculture" and the "cost-benefit calculations from the perspective of the animal keepers". They should have a "better basic knowledge of agriculture and its financial possibilities or limits".

Table 2. A separate study programme for farm veterinarians.

Statement (S)	(1) I totally agree (%)	(2) I agree (%)	(3) I agree somewhat (%)	(4) I disagree somewhat (%)	(5) I disagree (%)	(6) I totally disagree (%)
S1: "Of all the knowledge I have acquired during my veterinary studies in the field of 'farm animals', I basically only need a few things in my current professional life." (n=78; \bar{X} :3.51; SD±1.43)	10.26	15.38	24.36	17.95	26.92	5.13
S2: "There should be a separate study programme for farm veterinarians that only give them an understanding of the relevant aspects of the future professional field." (n=78; \bar{X} :3.82; SD±1.64)	7.69	20.51	15.38	15.38	20.51	20.51

However, not only business management aspects but also "agricultural realities" in general should be taught to a greater extent. Students should gain "basic agricultural knowledge (feeding, husbandry, milking)"; they need "agricultural training (...) to understand the production processes". Through this knowledge, they "learn to analyse the everyday problems of a farm...". With regard to training, one participant wrote as a kind of summary: "It should be a mix of agriculture and veterinary medicine, as diseases can only be understood and solved in a systemic context."

(e) Animal welfare

Participating veterinarians demanded more training on *animal welfare* issues (n=13). Various keywords like "animal welfare" or "animal protection" were mentioned here. A participant wrote that courses at veterinary universities should generally teach in a more intense way "that animals suffer, show pain and have emotions!!!".

(f) Other issues

The demand for *communication* (n=11) as a more important part of the training is usually exhausted in this keyword. If it is explained, it is stated that one should learn to "communicate more effectively"; that "training in communication with owners" was necessary. The required training in *law* (n=10) should comprise, among other things, more "labour law", the "legal situation" in general or "legally compliant action". Repeatedly, more training in *how to run a practice* was mentioned (n=9). This demand is closely linked to the already mentioned point *economics*, but the participants also discussed aspects beyond this: topics such as "employee management", "customer management", "founding a practice", "time management", "stress management", "organisational topics", "project work" or even "marketing" of the practice appeared here. The demand for more *psychology* (n=7) in veterinary medicine studies requires interpretation. The study participants mostly did not

explain this term. However, it seems plausible that the one explanation found in the answers can be regarded as typical: more psychology in the studies should help to "recognise the animal owner in their constraints". Generally speaking: "Psychology" aims at an adequate understanding and better handling of conflicts with animal owners.

A separate study programme for farm veterinarians?

Participants were asked to agree/disagree with the following statements in Table 2. The participants had the opportunity to comment on these closed questions. In these comments, there was a clear tendency: While specialisation is seen quite positively, a separate study programme for farm veterinarians is viewed critically: "At least more specialisation at the end of the studies should be made possible...". Or: "The conditions in livestock practices are changing rapidly, highly specialised practitioners will be needed. Veterinarians who cover everything are the exception rather than the rule." One participant replied: "I could well imagine a structure of the study programme based on a modular principle. A basic programme (maybe Bachelor) for everyone and then, for election, a Master's degree in Farm Animal Medicine with food, one for small animals and one for horses. However, on condition that one can do a Master's degree for one of the other animal species later in life – depending on how life develops –, you can adapt your profession, if necessary." One participant wrote: "I am a great friend of the undivided license to medicine, but nevertheless, the livestock sector must become more present at universities. It is not acceptable that you don't see a cattle claw in the whole course of your studies (except for optional electives). But a completely separate study programme is not bearable to me."

In these answers, it already becomes apparent that a separate study programme is viewed critically. This has also been explicitly stated in some comments: "On the question of whether there should be a special study programme for farm animal practitioners: I do not think that the study programme should be split up and that

graduates should be tied to a specific professional direction, but I do think that farm animal medicine, especially the care of livestock, should be further developed in the study programmes. In Copenhagen, there was one semester in the last year in which you could 'specialise' in one direction without being tied to it later. I think this is a very good approach." One participant replied: "As a student, you have to gain a good basic understanding of why and how things happen and interact physiologically. After that, there is so much to learn, whatever you want to specialise in. You find that, if you know something well, you can see parallels in other things, and then you have to learn the species-specific characteristics. But there must be a basic understanding!" Also, pragmatic reasons have been mentioned: "It is good that you can do anything after your studies. You never know where you will end up. Never specialise too soon." One participant put it like this: "Veterinarians must continue to be trained omnipotently!!!" Another participant wrote: "Real doctors treat more than one species!!!!".

What should be changed in livestock farming?

Participants in the study were asked: "If there are things that, in your opinion, need to be changed urgently in current livestock farming – what is that and why?" It was explicitly pointed out that this question referred to livestock farming in general, not necessarily to the veterinary profession (n=73). The answers show clearly: the participants wish for better conditions for the farm animals. The vast majority of answers can be traced back – whether directly or indirectly – to the demand that the farm animals should be better off in the stables. The main specific issues that were explicitly mentioned are an end to (permanent) tethering (n=5), a limitation of herd sizes (n=5) and the demand for animal-friendly solutions for interventions such as castration or dehorning (n=5). Furthermore, the participants discussed fundamentally necessary changes in the agricultural sector. The essential ones are described in the following.

(a) Economic restructuring

Participants discussed aspects concerning a necessary *economic restructuring* of the sector (n=25). Different actors were addressed: (aa) The essential role of *consumers* was underlined – and viewed critically: consumers demand a different kind of agriculture but are not willing to pay for it. "Consumers should also be willing to pay for their demands." What is needed is "an appropriate level of awareness of the end product among the population and a return of appreciation for a high-quality food product. It certainly cannot be that milk is cheaper than water in the supermarket. In my opinion, until that happens, not much can change in agriculture".

(bb) In this context, *farmers* were described, above all, as actors who are under great financial pressure and have, therefore, little room for manoeuvre: "Higher yields for producers" are necessary. "The economic pressure on farming businesses is too strong..." Farmers must be "significantly better paid" because "if the farmers get more money for their goods, 99% will automatically provide better conditions in their stables". (cc) The role of *food trade* was addressed similarly to the one of consumers: its importance was emphasised and its actions criticised. "The food trade (...) must not determine everything. The prices of the products must be higher." The money spent on food should not "disappear in large commercial enterprises"; "retailers should not be so powerful to drive down milk and meat prices". (dd) Some of the demands regarding a financial restructuring process also addressed *politics*. For example, one participant called for "higher prices of the end products paid by the consumers. If necessary, enforced by the state". Basically: "Society and politics must say what kind of animal husbandry they want..."

(b) Change in the public debate

It is not only about concrete practices – the public debate on farm animal husbandry also needs urgent changes (n=13). Farm veterinarians called for a science-based discussion: "The public debate must become more knowledge/fact-based! For that reason, school education must change..." No "ideologies should be pursued – scientific expertise must come first". It was stated that there should be a higher acceptance of livestock farming: "The acceptance of agriculture in general and the recognition of the great performance by our food producers must be raised." How could this be achieved? – Among other things, through more public relations work to inform the public about the realities of agriculture: the sector has to "advance public relations (and) explicitly educate consumers about modern systems". "Effective and collaborative public relations efforts would be great to provide a realistic picture of agricultural livestock farming." "Consumers should understand why and how we do what we do and pay more for good products."

(c) Improved control system

Several answers (n=11) can be subsumed under the category *improved control system*. What is the demand? – More controls, stricter controls, unannounced controls and other controllers. There is a need for "more controls" because "more controls by state authorities would certainly contribute a lot to animal welfare, but unfortunately such controls are far too rare!". It would be desirable to have "closer controls of farms and also hobby farms by the competent authorities, especially in

the case of already known infringements. In our region, cattle farms are inspected every 10 years on average". Especially "animal welfare criteria must be controlled much more strictly and with more motivation". There is a need for "controls worthy of the name, and not just paper checks, especially in slaughterhouses and livestock trade". "Unannounced controls of herds by the veterinary office (in particular calf husbandry, overcrowding)" are necessary. In the previous quotes it has already been mentioned that the participants would like to see more controls by state authorities, which are perceived as more independent. This wish was also explicitly expressed in some of the statements: "Away with QS, QM and what they all are called. We need an inspection clearly once a year by the responsible veterinary office. Notification four hours before is, in my opinion, sufficient to catch the big bad guys. The practitioners cannot take over these controls and other inspectors lack the knowledge of the animal protection law."

(d) Improved training of farmers with a focus on animal welfare

Participants would like to see *improved training of farmers with a focus on animal welfare aspects* (n=10). This topic should be more important than it has been so far in farmer education. For example, the following statement criticised shortcomings: "The training of young farmers is far too much dominated by economic objectives." What is missing? There is a need for "better training of full-time farmers with a commitment to regular further training in the areas of husbandry, feeding and animal protection/animal welfare". "The training of those involved with farm animals should be improved" "The know-how of farmers with regard to disease prevention should be reviewed" Some required a "certificate of competence" when it comes to keeping of farm animals.

(e) Critical questioning of performance optimisation

Participants came up with a fundamental rethinking: They demand a *critical questioning of the "bigger, better, faster" attitude*. (n=9). What do they mean by this? Basically, it is about stopping "striving for higher, faster, further – that is: more output...". Agriculture should "stop the constant striving for more and greater things!". If this demand is substantiated, it is about the demanded performance, which means the output of animals. The system must move "away from higher and higher milk yields". "The performance limit of the animals has been exceeded, the bred animals must become more robust again. 15,000 L milk or 40 piglets per sow/year are not the goal." Agriculture should "turn away from difficult breeding goals: extreme performance also means extreme susceptibility to a variety of factors". This thought

comes up repeatedly: the "too strong focus on performance in breeding" is problematic because "this (causes) production diseases". One veterinarian wrote: "The performance of the animals (milk and fattening) must decrease because the metabolic stress is extremely high. Farmers are often not able to meet the required feeding and husbandry conditions, or these requirements cannot be fulfilled at all, and as a consequence, the animals are sick and suffer. It must be recognised that it is much easier to keep animals healthy that do not deliver a top performance, even if the environment and feeding are not optimal. Rethinking must begin in the minds of farmers, who are unfortunately still too much 'calibrated' by their advisers to improve the output. More animals and a higher performance cannot be managed by the vast majority of farmers, and this misjudgement of their own abilities leads to many health problems and, consequently, to animal suffering."

Recommending the profession?

Participants were asked to what extent they would choose their profession again (Table 3). In an open question, the participants (n = 77) were asked: "Would you currently recommend students of veterinary medicine to become a farm veterinarian? Why or why not?" About 60% of the answers can be subsumed under *yes*; about 30% can be subsumed under *no*.

(a) Reasons for recommending the profession

Participants recommended the profession by referring to the *pleasure of the work itself* (n=25). The "job is fun", it is a "varied activity", with a "wide spectrum." It was pointed out repeatedly that the profession is "multifarious". "The veterinary profession is still incredibly exciting and versatile." There is "never routine at work, it is always exciting".

Participants rated the *contact with farmers positively* (n=10). Veterinarians deal with "predominantly nice farmers". "Farmers are grateful and 'faithful' when good work is done." Veterinarians are "usually dealing with nature-loving, down-to-earth people in the countryside". "I enjoy working closely with farmers..." Farmers are "significantly more pleasant customers than small animal owners".

Participants describe the job as *economically secure* (n=8). The occupational field is "economically safe!". With "hard work and dedication you earn a very good livelihood". There is "fair payment, especially in the pig sector"; in the livestock sector one can "with absolute certainty find a well-paid job". Comparisons are made with the small animal sector: one participant recommended the livestock sector because "there is an urgent need for young professionals and you can also

Table 3. Choosing the profession again.

Statement (S)	(1) I totally agree	(2) I agree	(3) I agree somewhat	(4) I disagree somewhat	(5) I disagree	(6) I totally disagree
S3: "I would choose a career as a farm veterinarian again." (n=78; \bar{X} :2.31; SD \pm 1.48)	41.03%	24.36%	11.54%	14.10%	3.85%	5.13%

make more money than in the hundreds of small animal practices in the Munich suburbs".

Participants emphasised the *gladdening contact with animals* (n=6). "The cow is one of the best things that could happen to mankind." My "heart hangs in the cattle barn and I would always choose the profession of a cattle veterinarian". There are "great animals" to deal with. "I like working with cows..." Or: "Because cows, pigs and poultry are great and exciting animals."

The answers discussed so far have been the focus, however, other reasons were occasionally given. For example: You can *really help the animals*. "Farm animals have a much too small lobby, for my feeling. Our commitment helps them to have a voice, and to be that voice is my life task." Participants would recommend their profession since it is about the *important good "food"*: "We all cannot live without food and drink. The veterinarians are part of the food production. Through our work we can also provide healthy food." Further, the job means to *work outdoors*: Farm veterinarians work in the "beautiful landscapes of Germany", the job is "outdoors", farm veterinarians are in the "fresh air".

(b) Reasons against recommending the profession

A topic that frequently appeared in the "no-answers" was the *societal, political criticism of livestock farming* (n=14) that could even lead to the end of this industry as a whole. The "pressure from politics and certain circles of society on agriculture, and thus on veterinarians, will increase in the future; the relationship is already today marked by mistrust and speechlessness. Although farm veterinarians are in demand on the job market, animal production is no longer wanted in Germany and will inevitably move abroad". "The livestock sector (is) more or less a discontinued model due to the current political situation." Livestock farming has "no future" in Germany. One participant wrote: "I assume that, due to the social demands on agriculture, it will largely disappear from the Central European countries within the next 25 years."

Another argument against the profession was that *earnings are too low* (n=7). The profession is not recommended "because, due to an incredibly high workload, you have relatively little time for other things in life and earn relatively little at the same time". "The income opportunities [are] better in other academic professions." "The high personal involvement is not reflected in the salaries of employed veterinarians."

The participants also talked about *fundamentally poor working conditions* (n=7). As long as "nothing is done to improve the working conditions for assistants (binding salary guidelines, working time records, paid overtime, ...) the job is uninteresting". Among other things, the following was criticised: "With working days between 10-12 h (as a rule!, it can also be more), in addition to on-call services, working every second weekend/holiday (of course without compensatory time off), being available at any time, unpaid overtime at very moderate pay, no appreciation of the work, as a rule also without having ever signed a work contract – one would rather look for a job far away from (farm animal) practice!"

The *legal situation was criticised* (n=4) and seen as a reason why the profession is not recommended: "Especially in the field of farm animals there is a discrepancy between legal requirements and reality (don't we all already have one foot in prison?)." "The legal obligations do not meet the requirements, they are divorced from reality, cannot be implemented; you cannot win."

Other topics were also addressed by individual participants. The *work is hardly medical*: "Many treatments [are done] by farmers. Now the work is more stock management, less medical." The veterinarian is a mere "medicine delivery service". The *work isolates the veterinarian*: "You work alone, you are permanently alone in the car, and in front of farmers you are usually alone with your opinion. You need a great deal of self-confidence and assertiveness!" The *increasing bureaucratisation* makes the job more difficult and not recommendable: "Documentation work at the end of the working day is unattractive." And finally, *dealing with farmers* was described as *strenuous*: there is "hardly any cooperation with the farmers. We are just a readily available service provider". When asked if they would recommend the profession, a participant answered: "No, no and no again. It is enough that I have wasted my life on the peasant pack."

Advice to future farm veterinarians

Participants were asked: "What advice would you give to young veterinary students who want to work in the livestock sector in the future?" (n=68).

In the answers, basic recommendations appeared such as: "There is no better profession than being a farm veterinarian. You can look forward to a great, interesting

and varied professional life.¹ Everything else that is told are fairy tales or horror stories by people who would not love another profession either.” But there were also warning voices advising against the profession, like: one should “study something else as quickly as possible”. In addition to these basic recommendations, there were also concrete suggestions. Three were mentioned particularly frequently.

(a) Choice of practice

The young veterinarians should think carefully about which practice they want to work in (n=20): Where do I learn most and where are the working conditions good? They should choose a “practice where people are willing to impart knowledge”. “In the beginning”, they should “work (in a practice) where there is good veterinary practice”. However, it is not only a question of where a young veterinarian is able to learn a lot but also a question of personal interaction and working conditions. One participant advised: “Look for a workplace where you find personal appreciation.” The supervisor is particularly important: “If you are not lucky enough to find one of the few good bosses, change the job as quickly as possible!” If young veterinarians consider working in a practice for a longer period of time or even founding one themselves, there was also advice on this: “Never try to run a large animal practice alone. It eats you up.” The recommendation was “no one-man practice, only as a team” because “a one-man practice is a discontinued model”.

(b) Internships

Students should do internships, ideally in veterinary practices as well as on farms (n=17): they should “do much internship, not only with a veterinarian but also on farms, to get an understanding of agriculture”. The rule is: “In any case, do an internship beforehand and prepare yourself for what awaits you there.” One should “do a lot of internships, maybe even on a big farm”.

(c) Detailed self-test

The advice on internships already contains an implicit advice that is also explicitly articulated: students should think carefully whether they really want to do the job (n=9). In other words, students should ask themselves whether they have enough “idealism”. They should “find out exactly what kind of stress the job entails”. Students should have “a good understanding of what’s coming”. One answer reads as follows: “If someone wants this with their heart and soul, they have to know that this cannot

be an eight-to-five job.” Future farm veterinarians “should know that ‘profession’ [*Beruf*] comes from ‘mission/calling’ [*Berufung*], and they should only make this decision if they are really sure they know what they are getting into. When you do farm animal practice, you are not doing much else, and you are living a slightly different life than most people”. It is important to “think twice whether you have enough idealism and resilience”.

DISCUSSION

The online survey investigated how German farm veterinarians perceive the future of their profession. For example: Which topics and issues should play a greater role in veterinary medicine studies in order to prepare students more adequately for their job? What should urgently be changed in livestock farming? Would they choose the profession again? Would they currently recommend students of veterinary medicine to become a farm veterinarian? Questionnaires focusing on open questions are explorative in nature. So, the survey can only provide an explorative insight into the lifeworld of German farm veterinarians. It thus creates an initial database that allows hypotheses to be framed, points to be made towards further (representative) studies, and generates new research questions.

The question of which topics should play a more important role in veterinary training in order to prepare future farm veterinarians adequately for their future job showed different roles and self-images of veterinarians, if not even a shift of these roles and self-images. More precisely:

(a) Participating veterinarians recommended that subjects concerning economics and practice management should be taught more intensively. The role that is addressed in these answers (and which should be more taken into account in veterinary training than it has been the case so far from the participants’ point of view) is the role of the veterinarian as an *entrepreneur*. Knowledge about entrepreneurship has been identified in various studies as a crucial competence of veterinarians (Bachynsky et al., 2013; Bok et al., 2014; Cake et al., 2014; Cake et al., 2016). German farm veterinarians join these voices that underline the importance of the corresponding skills.

(b) Another top answer calls for more knowledge transfer around herd health management. Veterinarians should be better trained to see the “big picture” of a farm instead of focusing only on individual patients. These results can be interpreted as a typical sign of a structural change of the profession: a shift from curative individual animal care towards herd health management can be observed worldwide in the livestock sector (Mee, 2007; Gerber et al., 2020). While curative practice focuses on treating sick animals, herd health management means that the veterinarian is mentoring the whole farming business with

¹ In the original German quote, the word “Beruf(ungs)leben” was used here, which is a wordplay. “Beruf” means “job”, “profession”. “Berufung” means “mission”, “calling”.

a view to animal health and other aspects. Exemplary questions are: What can be improved in feeding or ventilation in the barn? Which considerations are decisive for the farm in terms of genetics? Ideally, this permanent management prevents curative emergencies as much as possible. The given paper suggests talking about a kind of shift – not replacement – of self-understanding, which can be described as follows: a shift from the veterinarian as a *healer* to a kind of *health manager*. (To describe this shift in an extreme way: While the healer is paid for every sick animal they treat, the health manager could be paid for every animal that does *not* get sick.) The survey indicates that German farm veterinarians recognise this shift as a structural change of their profession.

(c) Since not everything that is crucial in the job can be taught at university, farm veterinarians call for more practical preparation. In this argumentation a role is addressed that the given paper proposes to be called *craftsman*: being a farm veterinarian means more than having theoretical knowledge; it also means having certain practical skills to apply this knowledge. These practical skills can only be learned through practice.

(d) Participants wish that agricultural knowledge should play a greater role in veterinary training. Hall and Wapenaar (2012) diagnosed that farm veterinarians describe themselves *inter alia* as “independent advisers” to farmers and “friends of farmers”, however, the results of the given survey pose the question of the extent to which farm veterinarians even see themselves as *part of agriculture*. This thesis can be derived not least from the other parts of the survey: farm veterinarians see themselves as a profession that is located in agriculture, that is, in food production. Participants repeatedly pointed out that they were working in the food production sector, speaking of a “we” when talking about agriculture or livestock farming.

(e) Participating veterinarians are calling for better training on what is generally seen as their core task: the veterinarian as the *advocate of animals* stands up for the interests of the animals. Accordingly, questions concerning animal welfare should play a greater role in the training.

(f) In the demand for more “communication” or “psychology”, there is a hint that being a veterinarian is also a communicative activity: the veterinarian as a *communicator* means that in this job you are confronted with people (animal owners, but also colleagues, employees, superiors or official veterinarians) with whom you have to enter into a – sometimes conflictual – dialogue. Even if “communication” and “psychology” are not top answers in this survey – these contents are still demanded by the participants. So, the answers of German farm veterinarians are in line with other surveys that underlined the importance of communication skills for veterinarians (Bristol, 2002; Gilling and Parkinson, 2009; Hodgson et al., 2013; Jaarsma et al., 2008; Rhind et al., 2011).

The demand for new and in-depth teaching contents shows the veterinarians’ awareness of the diversity of their roles. In particular, it shows that veterinarians know that theoretical medical expertise is only the basis of the profession, but far more skills are needed to get the job done. Furthermore, one outcome is worth mentioning: “ethics” is not among the top answers. Only a few participants used this term when asked in an open question about the subjects which should be more important in veterinary training. Several follow-up questions and interpretations are conceivable, for example: Does this outcome have to do with the average age of the participants (45.39 years)? Most of the participants have worked in this profession for a long time. Have they developed such good strategies to cope with moral challenges so that they do not see the necessity of ethical reflection? Furthermore, it can be assumed that the older participants did not get into contact with “ethics” during their training. Do they not demand “ethics” because they do not know that this subject may have something to do with their profession? But there is still another possible interpretation of why “ethics” is not required by the participants: maybe the most (!) urgent problems German farm veterinarians have in their daily work are simply not moral problems. However, the fact that “ethics” was not demanded should be examined more closely in future. In particular, it should be compared with similar but closed questions: if veterinarians are asked how important “ethics” is for their training, higher approval rates can be expected. But then the question arises what veterinarians understand by “ethics”. A study among official veterinarians showed that some understand better communication skills and an improved handling of media as “ethics” (Dürnberger, 2019a).

Veterinarians are repeatedly described as “advocates of animals” – but there is hardly any empirically based knowledge about the urgent improvements they want and demand in livestock farming. The study shows: In addition to concrete improvements – such as an end to (permanent) tethering – veterinarians demand, above all, changes to the system. (a) With regard to livestock farming, the veterinarians would like to see more financial leeway on the part of the animal owners. The farmers are lacking money. This economic pressure also affects the veterinarians – and of course the situation of the animals. Here, a crucial challenge of the profession becomes apparent: the veterinarians would like to treat the animals differently, but they are prevented from doing so by external obstacles – first of all the narrow financial framework of the livestock owners. In order to change this, the veterinarians consider that consumers, trade and politics have a duty, above all. All three actors are described rather negatively at this point: They do not fulfil their responsibilities or act only in their own interest.

Since politics is also repeatedly criticised at other points of the survey, the question arises to what extent

German farm animal practitioners show a kind of “disenchantment with politics” that is generally characterised, among other things, by a low level of trust in the morality, competence and assertiveness of the political sphere (cf. Arzheimer, 2002). (b) The veterinarians also call for a different kind of social debate about farm animal husbandry. At this point, it becomes clear that German farm veterinarians see themselves in a very similar way to the way German livestock farmers see themselves in the discourse (Dürnberger, 2019b): farmers and veterinarians sketch a part of the society as a group that has little knowledge about livestock husbandry, has lost touch with agriculture and food (production) and is influenced by other stakeholders who – from the farmers’ and veterinarians’ perspective – unfortunately dominate the debate on livestock farming. They feel that those involved in agriculture must themselves be heard as one of the most important voices in any social debate about agriculture. (c) In addition, farm veterinarians also have concrete suggestions for improvement with regard to the system. First of all, the control system must be changed: more checks, stricter controls, unannounced inspections and more controls by state authorities are needed. Furthermore, animal welfare should play a greater role in the training of farmers. On this issue, mandatory further training is also proposed – an issue that is controversially discussed in Germany. Finally, veterinarians warn against a “more, more, more” way of thinking. Many of them describe this permanent performance optimisation as a dead end – and it is at the expense of animal health. According to participants, the animals’ performance limits have been exceeded.

Finally, the study tried to survey a general atmospheric picture through questions whether veterinarians would choose the profession again or whether they would advise students to become farm veterinarians, and if so, what advice they would give to the youth. The advices are among others: They should know exactly what they are getting into. This requires direct contact with the job, for example through internships. The job can only be done successfully if veterinarians are convinced of what they are doing. It takes idealism, not least. After all, it depends on the concrete environment: Which practice? Which working hours? Which boss? Which team? These answers show what other studies also suggested: the role of team in the veterinary workplace is important when it comes to job satisfaction (Moore et al., 2014).

Bell et al. (2018) argue that there is little literature on what increases veterinarians’ job satisfaction because the literature focuses on distress and burnout. The results of this study can provide at least rough answers: Why do farm veterinarians recommend their profession, that is which facets do they like about it? They appreciate inter alia the variety of veterinary work (Cake et al., 2015), the contact with animal owners [similar for companion animals: see Shaw et al. (2012)], the contact with animals and the possibility to help them [(similar to Cake et al.

(2015)], but also economic security, as well as the importance of the work because it is about producing food and the possibility to work outdoors. So, German farm veterinarians describe their own profession as challenging, beautiful, important and satisfying. Correspondingly, a majority of the participants would choose this profession again: 41% agree completely, 24% agree.

However, aiming at a general atmospheric picture of the profession, one big issue must be mentioned: in quite a few answers there is a dark mood when it comes to the future of the profession and livestock farming in general. Naming this mood, this paper poses a question in its title from the perspective of farm veterinarians: *Are we the last of us? Are we working in the evening twilight of the profession?* Farm veterinarians see themselves as part of a world that is in decline, because from the point of view of some participants, it is possible that livestock farming will disappear from Germany in principle. The answers tell of working in and for a discontinued model that is no longer wanted, of a great deal of social mistrust, of the fact that livestock farming will move abroad and that it has no future in Germany anyway. The sometimes low earnings, the many hours of work, the difficult work-life balance, the laws that are almost impossible to comply with... all this seems less important in comparison to this gloomy prognosis. The perception that one is working in a business that is less and less wanted by German society seems to be a pressing issue and the main stressor.

Veterinary ethics that has the claim to accompany veterinarians in reflection processes must know the lifeworld of the veterinarians. The study shows that some veterinarians find the declining societal acceptance of livestock farming problematic and stressful. Accordingly, this topic should also be dealt with in ethics seminars, creating space for veterinarians to discuss issues that are bothering them. Further, the survey gives hints on improving the study programme or further training courses for farm veterinarians. In particular, training courses about concrete practice management skills should be offered. It is recommended that prospective veterinarians who are about to choose a branch get a better insight into the actual everyday life of a veterinarian. Accordingly, more internships are demanded. Politicians and legislation should recognise farm veterinarians as a professional group that, despite its status as experts, feels ignored in the decisive discussion processes.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

ACKNOWLEDGEMENTS

The author is grateful to all participants in the survey as

well as MSD Tiergesundheit, "Der Hoftierarzt" and "Bundesverband Praktizierender Tierärzte e.V."

REFERENCES

- Arzheimer K (2002). Politikverdrossenheit. Bedeutung, Verwendung und empirische Relevanz eines politikwissenschaftlichen Begriffes. Westdeutscher Verlag, Wiesbaden.
- Bachynsky EA, Dale VH, Kinnison T, Gazzard J, Baillie S (2013). A survey of the opinions of recent veterinary graduates and employers regarding early career business skills. *Veterinary Record* 172(23):604-609.
- Bell MA, Cake MA, Mansfield CF (2018). Beyond Competence: Why We Should Talk About Employability in Veterinary Education. *Journal of Veterinary Medicine and Education* 45(1):27-37.
- Bergstra TJ, Hogeveen H, Stassen EN (2017). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values* 34(2):393-405.
- BMEL (German Federal Ministry of Food and Agriculture) (2017). Nutztierhaltungsstrategie. Zukunftsfähige Tierhaltung in Deutschland. Retrieved February 10, 2019. http://www.bmel.de/SharedDocs/Downloads/Tier/Nutztierhaltungsstrategie.pdf?__blob=publicationFile. (accessed 26 February 2020).
- Boehm J, Kayser M, Spiller A (2010). Two Sides of the Same Coin? Analysis of the Web-Based Social Media with Regard to the Image of the Agri-Food Sector in Germany. *International Journal on Food System Dynamics* 3:264-278.
- Bok HG, Teunissen PW, Boerboom TB, Rhind SM, Baillie S, Tegzes J, Annandale H, Matthew S, Torgersen A, Hecker KG, Hårdi-Landerer CM, Gomez-Lucia E, Ahmad B, Muijtjens AM, Jaarsma DA, van der Vleuten CP, van Beukelen P (2014). International survey of veterinarians to assess the importance of competencies in professional practice and education. *Journal of the American Veterinary Medical Association* 245(8):906-913.
- Boogard BK, Oosting SJ, Bock BB (2008). Defining sustainability as a socio-cultural concept: Citizen panels visiting dairy farms in the Netherlands. *Livestock Science* 117: 24-33.
- Boogard BK, Bock BB, Oosting SJ, Wiskerke JSC, van der Zijpp AJ (2011). Social Acceptance of Dairy Farming: The Ambivalence Between the Two Faces of Modernity. *Journal of Agricultural and Environmental Ethics* 24(3):259-282.
- Bristol DG (2002). Using alumni research to assess a veterinary curriculum and alumni employment and reward patterns. *Journal of Veterinary Medicine and Education* 29(1):20-27.
- Busch G, Gaulty S, Spiller A (2015). Wie wirken Bilder aus der modernen Tierhaltung der Landwirtschaft auf Verbraucher? Neue Ansätze aus dem Bereich des Neuromarketings, in: Schriftenreihe der Rentenbank 31, Die Landwirtschaft im Spiegel von Verbrauchern und Gesellschaft, pp. 67-94.
- Cake MA, Rhind SM, Baillie S (2014). The need for business skills in veterinary education. Perception vs evidence, in: Collete, H. (Ed.), *Veterinary Business and Enterprise*. Theoretical foundations and practical cases. Elsevier, pp. 9-20.
- Cake MA, Bell MA, Bickley N, Bartram DJ (2015). The life of meaning: a model of the positive contributions to well-being from veterinary work. *Journal of Veterinary Medicine and Education* 42(3):184-193.
- Cake MA, Bell MA, Williams JC, Brown FJ, Dozier M, Rhind SM, Baillie S (2016). Which professional (non-technical) competencies are most important to the success of graduate veterinarians? A Best Evidence Medical Education (BEME) systematic review: BEME Guide No. 38. *Medical Teaching* 38(6):550-563.
- Clark B, Stewart GB, Panzone LA, Frewer LJ (2016). A Systematic Review of Public Attitudes, Perceptions and Behaviours Towards Production Diseases Associated with Farm Animal Welfare. *Journal of Agricultural and Environmental Ethics* 29(3):455-478.
- Christoph-Schulz I, Brümmer N, Rovers AK (2019). Gesellschaftliche Wahrnehmung der Legehennen- und Masthühnerhaltung in Deutschland. *Austrian Journal of Agricultural Economics and Rural Studies* 28(15):111-119.
- Dürnberger C (2019a). It's Not About Ethical Dilemmas: A Survey of Bavarian Veterinary Officers' Opinions on Moral Challenges and an e-Learning Ethics Course. *Journal of Agriculture and Environmental Ethic* 32(5-6):891-903.
- Dürnberger C (2019b). 'You should be slaughtered!' Experiences of criticism/hate speech, motives and strategies among German-speaking livestock farmers using social media. *International Journal of Livestock Production* 10(5):151-165.
- Düwell M (2008). *Bioethik. Methoden, Theorien und Bereiche*. Metzler, Stuttgart and Weimar.
- Fischer J (2001). Die Begründungsfalle. Plädoyer für eine hermeneutisch ausgerichtete theologische Ethik. *Zeitschrift für Evangelische Ethik* 46:163-167.
- Gerber M, Dürr S, Bodmer M (2020). Survey among livestock veterinarians from the Canton of Fribourg investigating the topics of herd-health management, counselling and the use of antimicrobial drugs. *Schweiz Arch Tierheilkd* 162(1):23-36.
- Gilling ML, Parkinson TJ (2009). The transition from veterinary student to practitioner: a "make or break" period. *Journal of Veterinary Medicine and Education* 36(2):209-215.
- Gier N, Krampe C, Kenning P (2018). Wahrnehmung der Nutztierhaltung – alles eine Frage der Kommunikation? *Journal of Consumer Protection and Food Safety* 13(2):177-182.
- Groß S, Roosen J (2018). Der Einfluss von Nachrichtentexten über die Tierhaltung auf das soziale Vertrauen in Landwirte. *Journal of Consumer Protection and Food Safety* 13(2):190-196.
- Grunert KG, Sonntag WI, Glanz V, Forum F (2018). Consumer interest in environmental impact, safety, health and animal welfare aspects of modern pig production: Results of a crossnational choice experiment. *Meat Science* 137:123-129.
- Hall J, Wapenaar W (2012). Opinions and practices of veterinarians and dairy farmers towards herd health management in the UK. *Veterinary Records* 170(17):441.
- Hodgson JL, Pelzer JM, Inzana KD (2013). Beyond NAVMEC: competency-based veterinary education and assessment of the professional competencies. *Journal of Veterinary and Medical Education* 40(2):102-118.
- Jaarsma DADC, Dolmans DHJM, Scherpbier AJJA (2008). Preparation for practice by veterinary school: a comparison of the perceptions of alumni from a traditional and an innovative veterinary curriculum. *Journal of Veterinary Medical Education* 35(3):431-438.
- Kayser M, Spiller A (2012). Das Image der verschiedenen Fleischarten aus KonsumentInnen-Sicht, in: Hambrusch, J., Hoffmann, C., Kantelhardt, J., Oedel-Wieser, T. (Eds.), *Jahrbuch der österreichischen Gesellschaft für Agrarökonomie* 21(1):23-31.
- Krystallis A, de Barcellos MD, Kügler JO, Verbeke W, Grunert KG (2009). Attitudes of European citizens towards pig production systems. *Livestock Science* 126:46-56.
- Kuckartz U (2012). *Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung*. Beltz Juventa, Weinheim and Basel.
- Lesch W (2006). *Hermeneutische Ethik. Narrative Ethik*. In: Düwell, M., Hübenthal, C., Werner, M.H. (Eds.), *Handbuch Ethik*. Stuttgart and Weimar, Germany: J.B. Metzler, pp. 231-242.
- Magalhães-Sant'Ana, M, Hanlon A (2016). Straight from the Horse's Mouth: Using Vignettes to Support Student Learning in Veterinary Ethics. *Journal of Veterinary Medicine Education* 43(3):321-330.
- Mayring P (2015). *Qualitative Inhaltsanalyse. Grundlagen und Techniken*. 12th, revised edition. Beltz Verlag, Weinheim.
- Mee JF (2007). The role of the veterinarian in bovine fertility management on modern dairy farms. *Theriogenology Suppl* 1(68):S257-65.
- Moore IC, Coe JB, Adams CL (2014). The role of veterinary team effectiveness in job satisfaction and burnout in companion animal veterinary clinics. *Journal of American Veterinary Medicine Association* 245(5):513-524.
- Morgan CA, McDonald M (2007). Ethical dilemmas in veterinary medicine. *Veterinary Clinics: Small Animal Practice* 37(1):165-179.
- Mullan S, Fawcett A (2017). *Veterinary ethics: Navigating tough cases*. 5m Publishing: Sheffield.
- Regan T (1983). *The Case for Animal Rights*. University of California Press, Berkeley.
- Rhind SM, Baillie S, Kinnison T (2011). The transition into veterinary

- practice: opinions of recent graduates and final year students. *BMC Medical Education* 11(1):64.
- Rollin B (2006). *An Introduction to Veterinary Medical Ethics: Theory And Cases*. 2nd ed. Wiley-Blackwell: Oxford.
- Roosen J, Kalkbrenner B, Fischer S (2018). Adequate animal welfare standards from a citizen perspective – A stated choice experiment on broiler. *Journal of Consumer Protection and Food Safety* 13(2):210-217.
- Rovers AK, Christoph-Schulz IB, Brümmer N, Saggau D (2017). Trust no one? Citizens' concerns regarding the pork and dairy supply chain. *International Journal of Food System Dynamics*, pp. 87-93. DOI:10.18461/pfsd.2017.1709.
- Rovers A, Wildraut C, Mergenthaler M, Sonntag WI, von Meyer-Höfer M, Spiller A, Luy J, Saggau D, Brümmer N, Christoph-Schulz I (2018). Analyse der Nutztierhaltung durch unterschiedliche gesellschaftliche Gruppen. *Journal of Consumer Protection and Food Safety* 13(2):165-170.
- Schmitz F (2016). Animal ethics and human institutions: Integrating animals into political theory, in: Garner, R., O'Sullivan, S. (Eds.). *The Political Turn in Animal Ethics*. Rowman & Littlefield, pp. 33-50.
- Shaw JR, Adams CL, Bonnett BN, Larson S, Roter DL (2012). Veterinarian satisfaction with companion animal visits. *Journal of American Veterinary Medicine Association* 240(7):832-841.
- Sonntag WI, Spiller A (2018). Measuring Public Concerns? Developing a Moral Concerns Scale Regarding Non-Product Related Process and Production Methods. *Sustainability* 10(5).
- Special Eurobarometer (2018). Special Eurobarometer 473. Europeans, Agriculture and the CAP. Retrieved February 10, 2019. https://data.europa.eu/euodp/data/dataset/S2161_88_4_473_ENG (accessed 26 February 2020).
- Tannenbaum J (1993). Veterinary medical ethics: a focus of conflicting interests. *Journal of Social Issues* 49:143-156.
- WBA (Scientific Advisory Board for Agricultural Policy at the German Federal Ministry of Food and Agriculture) (2015). Wege zu einer gesellschaftlich akzeptierten Nutztierhaltung. Retrieved February 10, 2019. http://www.bmel.de/DE/Ministerium/Organisation/Beiraete/_Texte/Agr_Veroeffentlichungen.html (accessed 26 February 2020).
- Weible D, Christoph-Schulz I, Salamon P, Zander K (2016). Citizens' perception of modern pig production in Germany: a mixed-method research approach. *British Food Journal* 118(8):2014-2032.

Full Length Research Paper

The performance of artificial insemination delivery system in Amhara, Oromia, SNNP and Tigray Regions of Ethiopia

Kassahun Melesse^{1*}, Ashenafi Mengistu¹ and Driba Geleti²

¹College of Veterinary Medicine and Agriculture, Addis Ababa University, Debre Zeit, Ethiopia.

²Ethiopian Institute of Agricultural Research, P. O. Box 2003, Addis Ababa, Ethiopia.

Received 19 December, 2019; Accepted 27 April, 2020

The study was conducted in Amhara, Oromia, Southern Nations Nationalities and Peoples and Tigray regions of the country to provide information on the performance of Artificial Insemination (AI) service delivery system, its seasonality and effectiveness. Semi-structured questionnaire was prepared to interview AI technicians (on their performance and related issues) and farmers (about the outcome of AI services). Data on field performance were received directly from AI technicians using a pre-restructured reporting format. A follow-up calving survey for AI services were provided to farmers was conducted in March 2019 to know the outcome of insemination services provided to farmers. Peak season falls from August to December when AI technicians on average perform 6.7 inseminations per day. January, February, June, and July were categorized as regular season with daily average insemination of 3.8. March, April, and May are off-season with an average of only 2.2 inseminations per day. The seasonal variation is mainly associated with availability of feed. Field level actual performance data showed significant difference ($P < 0.05$) in the number of inseminations provided per AI technician per month among regions and between male and female AI technicians with an overall average insemination of 39.3. The highest AI services reported in the month of October. The Service per Conception (SPC) reported by AI technicians was not significantly different among regions ($P > 0.05$) with mean SPC of 2.13. About 2.6 SPC obtained from a follow-up survey conducted with farmers who received AI service in a specified period. About 62% conception rate and 82% calving rates are obtained in this study.

Key words: Cattle, farmers, performance, technicians, semen.

INTRODUCTION

In a country, such as Ethiopia, where there is huge cattle population, the dairy sector can significantly contribute to the wellbeing of the dairying households, the nutrition of consumers, and the economy of the country at large. However, the sector is challenged by technical,

infrastructural and policy constraints (Wytze et al., 2012). With the available 60.4 million cattle population (CSA, 2018), the country is not self-sufficient in milk production, rather it has been investing a significant sum of foreign currency for importing milk and milk products.

*Corresponding author. E-mail: kasishmele@gmail.com.



Figure 1. Map of Amhara, Oromia, SNNP and Tigray regions.

To fill the gap between demand and supply, improving the productivity of dairy cattle through genetic improvement is of paramount importance. As proven in many countries, an effective and efficient strategy to improve dairy cattle productivity is to breed dairy cows using proven semen via Artificial Insemination (AI).

Though it is now close to seven decades since crossbreeding activities started in Ethiopia, the proportion of both hybrid and exotic breeds is not greater than 2% out of 60.4 million cattle population (CSA, 2018). This indicates a crossbreeding program that has been implemented in the country over the last several decades through the application of AI technology is quite ineffective (Nuraddis et al., 2014). This can mainly be justified by the availability of an insignificant proportion of crossbred cattle population. One major factor contributing to such inefficiency is the very low conception rate and the accompanied high age at first calving ranged between 34 months (Hunde et al., 2015) and 44 months (Effa et al., 2006).

AI is predominantly provided by the government with a highly subsidized price (less than 10 birr or 0.4 USD) from the public side. The private sector involvement both in terms of input supply and service delivery is not significant as compared to other East African countries such as Kenya (Dickson et al., 2018). Several contributing factors are mentioned in various reports (Gebregiorgis et al., 2016; Tessema and Atnaf, 2015; Zerihun et al., 2013; Desalegn et al., 2009) for the

inefficiency of AI service delivery system in the country. The main reasons for this include lack of the necessary inputs and equipment, unreliable supply of liquid nitrogen, poor quality of semen. Moreover, lack of proper record-keeping at farm level is also be considered as an important factor affecting the country's dairy cattle breeding and improvement. Though several scholars tried to identify major factors for inefficient AI delivery system in different parts of the country, the performance of the AI delivery system is not quantified sufficiently. Therefore, the objective of this study is to provide information on the performance of AI delivery system in terms of the number of inseminations, service per conception, conception rate and calving rates.

MATERIALS AND METHODS

Study areas

The study was conducted in Amhara, Oromia, Southern Nations Nationalities and Peoples (SNNP) and Tigray Regions. These regions were purposively selected due to their potential for dairy production and huge government and other development partners' efforts in improving the dairy sector in these regions. About 16.1, 24.4, 11.9 and 4.8 million cattle reported to be available in Amhara, Oromia, SNNP and Tigray regions, respectively (CSA, 2017, 2018) (Figure 1).

Study components

The study was mainly undertaken using: questionnaire survey, filed

level performance recording and calving survey two methods.

Questionnaire survey

AI technicians' interview was conducted in July and August 2017 with randomly selected AI technicians operating in Amhara, Oromia, SNNP and Tigray regions. The interview was focused mainly on their performance-related issues and seasonality of AI service. A total of 161 AI technicians from the four regions (49 from Amhara, 53 from Oromia, 36 from SNNP and 23 from Tigray regions) were randomly selected and interviewed using a structured questionnaire. Both qualitative and quantitative data collected through this structured questionnaire.

AI technicians field-performance recording

Data on field-performance of AI technicians in Amhara, Oromia, SNNP and Tigray regions received from technicians from October 2016 through December 2018 to measure the actual performance of AI technicians using a format prepared for this study.

Calving survey

A follow-up calving survey for AI services provided to farmers was conducted in March 2019 in the four studied regions to better understand the performance of AI technicians in terms of conception and calving rates. For this purpose, the list of farmers who received AI service between February and May 2018 was purposefully selected and prepared to be used as a sampling frame. The data is mainly used for the purpose of conception rate (percentage of conceived animals from the total number of inseminated), calving rate from conceived animals (percentage of calved animals from the total conceived) and calving rate from all inseminated animals (percentage of calved animals from the total inseminated animals).

Then, a multi-stage random sampling system was followed to select woredas, kebeles, and farmers from each of the four target regions. Sample farmers were then selected randomly from each woreda and kebele using assigned random numbers. Sample size was estimated at 90% significance level in each region. As suggested by Suresh and Chandrashekar (2012) and Daniel (1999), the following formula was used to determine the sample size for each region since the population size for all region is known.

$$\text{Sample Size} = [z^2 * p(1-p)] / e^2 / 1 + [z^2 * p(1-p)] / e^2 * N$$

Where:

N = population size, z = z-score, e = margin of error, p = standard of deviation.

A total of 1,083 farmers (268 from Amhara, 274 from Oromia, 269 from SNNP and 272 from Tigray regions) were interviewed on the outcome of AI services provided to them.

Data analysis

Primary data collected from AI technicians and farmers through the survey tools entered in Microsoft Excel and Statistical Package for Social Science (SPSS) version 20 (SPSS, 2011). For data analysis, Statistical Analysis System (SAS - Version 9) (SAS, 2004) was used based on the type of variable. For quantitative data, the General Linear Model (GLM) of the SAS was used and means within the same category were separated using the Least Significant Difference (LSD) for those F tests that declared

significance ($P < 0.05$).

RESULTS AND DISCUSSION

Number of AI services provided

As per the interview result with AI technicians, significant ($P < 0.05$) difference was observed in the number of AI services provided during regular, peak and off-seasons among the four regions (Table 1). An overall average of 3.76, 6.70 and 2.23 inseminations provided per day per AI technician during regular, peak and off-seasons, respectively (overall average 4.23 inseminations per day per AI technician). In all cases, AI technicians in SNNP region were providing the highest number of inseminations per day followed by Oromia and Tigray regions.

In contrast to this survey-based result, much lower field level actual performance is obtained in the four studied regions (Table 2). Field level actual performance data showed significant difference ($P < 0.05$) in the number of inseminations provided per AI technician per month among regions and between male and female AI technicians with an overall average insemination of 39.3 (nearly 1.5 inseminations per day if the average 6.6 working days per week as reported by AI technicians are considered). This is 47% lower than the survey-based performance report (4.23 inseminations/day/AI technician). The average performance of AI technicians reported in both cases of the present study is higher than Camilla (2013) who reported 11-25 inseminations per month per AI technician in Uganda. Though private AI technicians were expected to provide a greater number of inseminations per month, the difference between public and private AI technicians was not significant ($P > 0.05$). Public AI technicians were providing a higher number of inseminations (40) per month than that of private AI technicians (32). This might be related to the small number of private AI technicians considered in this study.

Seasonality of AI service

Artificial Insemination (AI) technicians requested to categorize months of a year into regular, peak and off-seasons based on the number of inseminations they provided daily. The study confirms the delivery of AI service followed a seasonal pattern. As shown in Figure 2, an overall average of 6.7 inseminations is reported per day per AI technician during peak season which is 26.7% more than the number of inseminations provided during regular season (3.8 inseminations/day/AI technician). The peak season lies between August and December when availability of ample feed resources is secured as these months fall immediately after the long rainy season and in the harvesting season for most cereal crops. Green pasture is available for grazing purpose and animals can

Table 1. Average number of AI services provided per day during regular, peak and off-season in Amhara, Oromia, SNNP and Tigray regions.

Row labels	N	Number of AI services provided per day during		
		Regular season (Mean±SE)	Peak season (Mean±SE)	Off-season (Mean±SE)
Amhara	49	2.65±0.30 ^b	5.18±0.50 ^b	1.31±0.16 ^c
Oromia	53	4.42±0.56 ^a	7.47±0.67 ^a	2.51±0.36 ^{ab}
SNNP	36	4.56±0.39 ^a	7.81±0.73 ^a	3.43±0.62 ^a
Tigray	23	3.39±0.41 ^{ab}	6.43±0.84 ^{ab}	1.74±0.23 ^{bc}
Total	161	3.76±0.24	6.70±0.34	2.23±0.20

Means with different superscripts in the same column significantly different (P<0.05).

Table 2. Average number of AI services provided per month and per day.

	Number of AIs/Month/AI tech	Number of AIs/day/AI tech	N
Region	***		
Amhara	34.87±3.00 ^c	1.16±0.10 ^b	105
Oromia	34.48±2.07 ^c	1.15±0.07 ^b	145
SNNP	53.15±3.64 ^a	1.77±0.12 ^a	69
Tigray	42.42±3.55 ^b	1.41±0.12 ^b	65
Type			
Public	40.27±1.54 ^{NS}	1.34±0.52 ^a	341
Private	31.52±4.85 ^{NS}	1.05±1.61 ^a	43
Gender	***		
Male	41.80±1.61 ^a	1.39±0.05 ^a	331
Female	23.59±2.88 ^b	0.79±0.10 ^b	53
Overall	39.29±1.48	1.31±0.05	384

N: Number of respondents.

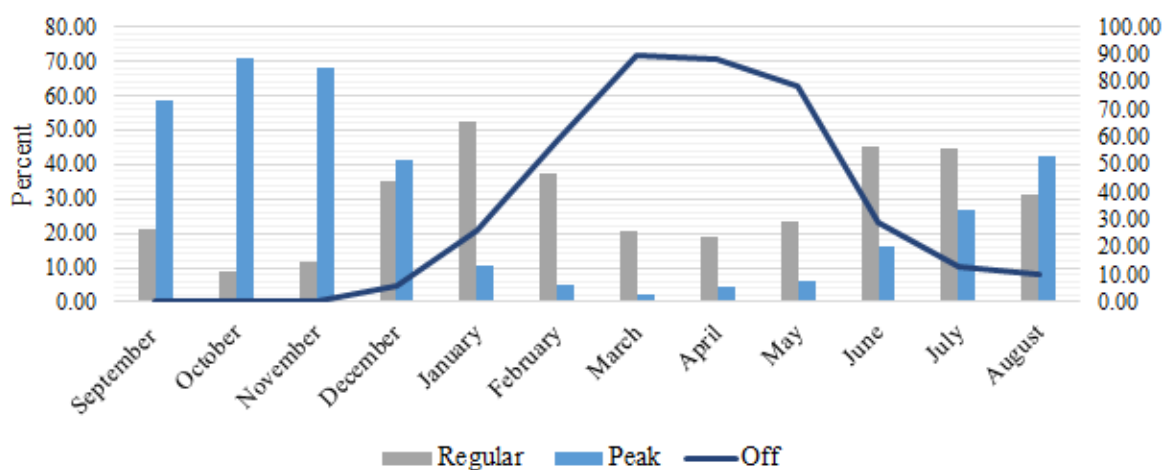


Figure 2. Seasonality of AI service provision in Amhara, Oromia, SNNP and Tigray regions.

easily fulfill their energy requirement during these months of the year.

The regular season falls in January, February, June, and July when AI technicians provided daily average



Figure 3. Overall seasonality of AI service based on the number of AI services provided from October 2016 to December 2018.

insemination of 3.8. In January and February green pastures normally dry, however a significant amount of crop residues are available in most parts of the country as these months fall immediately after the harvesting season. June and July are part of the long rainy season and are just immediately after the short rainy season when green feed especially of green pasture is available to a significant extent in the field. March, April and May are off-season when on average only 2.23 inseminations per day is provided. Information on seasonality of AI service can be used to allocate the required input and logistic for AI service delivery instead of allocating such inputs and logistics regularly throughout the year. AI service delivery system can strategically be planned and implemented based on this information.

To support the questionnaire survey result regarding seasonality of AI service provision, performance data (between October 2016 and December 2018) received from AI technicians on the number of AI services provided and the result is shown in Figure 3. For ease of data management and presentation, months of a year were grouped into quarters following the Ethiopian budget year. June, July and August were classified as Quarter 1, September, October and November as Quarter 2; December, January and February as Quarter 3 and March, April and May as Quarter 4. The result of data collected on-field performance strongly agrees with the survey result and confirmed the seasonality of AI service delivery system. Peak service was delivered in Quarter 2 (September, October and November) and the service reached its lowest level in Quarter 4 (March, April and May).

Service per conception

AI technicians participated in this study were interviewed on their performance regarding service per conception (SPC) based on their available performance data in their case book. The SPC reported by AI technicians was not significantly different among regions ($P>0.05$) with mean SPC of 2.13. The highest (2.24) SPC reported from SNNP region followed by Amhara region (2.17), Oromia (2.11) and Tigray region (1.95).

To support the AI technicians' interview regarding service per conception, in March 2019 a follow-up survey was conducted with 1,083 farmers who received AI service between February and May 2018 in the study regions. About 2.6 inseminations were required for a cow to conceive. Data received from NAIC on total inseminations and confirmed pregnancies from 2009/2010 to 2013/2014 revealed resulted in a 2.42 SPC. The SPC in this study is much higher than Desalegn et al. (2009) and Ali et al. (2013) who reported 1.88 and 1.55, respectively. It is also higher than the SPC reported in Kenya (1.9) under a controlled environment (Kinyua, 2016)

Conception and calving rates

Under normal conditions, collecting information on conception and calving has various challenges. Time constraint is among the major factors for AI technicians to follow and collect information on the outcome of AI services they provided. Thus, calving survey was undertaken in March 2019 to evaluate the performance of

Table 3. Number of cows inseminated, conceived and calved; conception and calving rates in Amhara, Oromia, SNNP and Tigray Regions.

Region	Number of			Conception rate (%)	CR -from conceived (%)	CR - from inseminated (%)
	Cows inseminated	Conceived	Calved			
Amhara	268	173	143	64.6	82.7	53.4
Oromia	274	199	165	72.6	82.9	60.2
SNNP	269	156	129	58.0	82.7	48.0
Tigray	272	142	115	52.2	81.0	42.3
Overall	1,083	670	552	61.9	82.4	51.0

CR= Calving rate.

AI service in terms of conception and calving rates. The result of the survey is presented in Table 3.

Overall average of 62% conception rate, 51% (from all received AI) and 82% (from conceived) calving rates are reported in this study. The limitation in undertaking such a follow-up survey was improper animal identification, lack of record-keeping, lack of basic farmer related information to properly identify the location of farmers and infrastructural problem. These challenges suggest the importance of proper animal and farm identification system and record-keeping to successfully undertake a follow-up survey. If this is in place different conception and calving rates would be obtained. The five years data received from NAIC, on the other hand, revealed a 45% conception rate (from total inseminations). The conception rate reported in this study is higher than Ali et al. (2013), Desalegn et al. (2009), Gebregiorgis et al. (2016), and Tatek et al. (2011) who reported 48.3, 40.9, 27 and 56%, respectively. It is also higher than Mwambilwa et al. (2013) who reported a 48% conception rate in Zambia. The calving rate in this report is also higher than Gebregiorgis et al. (2016) who reported 37% in Tigray region, Ethiopia. The discrepancy among the different reports is related to the method of data collection. The NAIC data is based on direct reports obtained and synthesized from regional bureaus and may not reflect the exact performance of the crossbreeding program.

CONCLUSION AND RECOMMENDATION

The performance of AI technician (especially of the number of inseminations provided per AI technician) seems low to bring the desired impact in the multiplication of crossbreds and then to improve productivity. The performance is relatively better in Tigray region when compared to other three regional states. Due attention should be given to improve AI technicians' performance through availing necessary inputs, logistics, and infrastructures. Establishment of a strong monitoring system to follow-up the performance of their AI technicians is also very essential. Result based carrier structure, promotion and recognition system need to be

established to motivate AI technicians to perform a greater number of inseminations.

All performance-related results reported in this study suggests the importance of establishing proper and structured data collection and reporting system. There should be a strong linkage, network and communication among regional, zonal and woreda level breed improvement, animal health and extension offices to implement the envisaged reporting system.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGMENTS

The authors appreciate Land O'Lakes Venture 37 for the support and for allowing the use of data for academic purpose. The authors also thank AI technicians, farmers, regional bureau livestock experts for their active participation and required support.

REFERENCES

- Ali T, Lemma A, Yilma T (2013). Reproductive performance of dairy cows under artificial insemination in south and northwest part of Ethiopia. *Livestock Research for Rural Development* 25 (12):191.
- Camilla E (2013). The use of artificial insemination in dairy farms in urban/peri-urban Kampala, Uganda – a study of knowledge, attitude and practices. Swedish University of Agricultural Sciences, Faculty of Veterinary Medicine and Animal Science, Degree project, Veterinary Program, Uppsala 2013.
- CSA (2017). Federal Democratic Republic of Ethiopia Central Statistical Agency. *Agricultural Sample Survey, 2016/17 [2009 E.C.]*, Volume II, Report on Livestock and Livestock Characteristics (Private Peasant Holdings). Statistical Bulletin 585. April 2017.
- CSA (2018). Federal Democratic Republic of Ethiopia Central Statistical Agency. *Agricultural Sample Survey, 2017/18 [2010 E.C.]*, Volume II, Report on Livestock and Livestock Characteristics (Private Peasant Holdings). Statistical Bulletin 587. April 2018.
- Daniel WW (1999). *Biostatistics: A foundation for Analysis in the Health Sciences: 7th Edition*. New York: John Wiley & Sons.
- Desalegn G/M, Merga B, Azage T, Kelay B (2009). Status of artificial

- insemination service in Ethiopia. In: The 17th Annual Conference of the Ethiopian Society of Animal Production (ESAP), Sept 24-26, 2009 Addis Ababa, Ethiopia, pp.87-104.
- Dickson NK, Gideon O, John N (2018). Estimating pastoralists' willingness to pay for artificial insemination in arid and semi-arid lands of Kenya. *Journal of Development and Agricultural Economics* 10(8):262-270.
- Effa K, Hegde BP, Tesfaye K (2006). Lifetime production and reproduction performances of *Bos taurus* x *Bos indicus* crossbred cows in the central highlands of Ethiopia. *Ethiopian Journal Animal Production* 6(2):37-52.
- FAO (2002). *World Agriculture 2030. Main findings.* <http://www.fao.org/english/newsroom/news/2002/7833-en.html>
- Gebregiorgis A, Alemselem B, Tadesse G (2016). Status of Artificial Insemination in Tigray Regional State, "Constraints and Acceptability under Field Condition. *Journal of Dairy Veterinary and Animal Research* 3(3):00078.
- Hunde DGM, Tadelle D, Getnet A, Million T, Johan S (2015). Milk Yield and Reproductive Performance of Pure Jersey Dairy Cattle in the Central Highlands of Ethiopia. *Livestock Research for Rural Development* 27 (130).
- Kinyua J (2016). Evaluation of Artificial Insemination Services Performance in a Smallholder Dairy Herd Under Extensive Management: A Case Study of KALRO- Lanet Herd, Kenya. *Weber Agricultural Research and Management* 2(191):692-694.
- Mwambilwa K, Yambayamba KE, Joseph S (2013). Evaluation of the reproductive performance and effectiveness of artificial insemination on smallholder dairy farms in Zambia. *Scholarly Journal of Agricultural Science* 3(10):391-400.
- Nuraddis I, Reta H, Abidu M (2014). Assessment of Problems Associated with Artificial Insemination Service in Selected Districts of Jimma Zone. *Journal of Reproduction and Infertility* 5(2):37-44.
- SAS (2004). *Users Guide. Version 6.12. Statistical Analysis System (SAS) Institute, Inc. Carry, NC.*
- SPSS (2011). *Statistical Procedures for Social Sciences (SPSS). IBM® SPSS® Statistics 20. IBM Corp. Chicago, USA.*
- Suresh KP, Chandarashekara S (2012). Sample Size Estimation and Power Analysis for Clinical Studies. *Journal of Human Reproductive Science* 5(1):7-13.
- Tessema R, Atnaf A (2015). Assessment of Problems Associated with Artificial Insemination Services in and Around Gondar Town, North West Ethiopia. *Journal of Reproduction and Infertility* 6(2):22-26.
- Tatek W, Yoseph T, Aynalem H (2011). Factors affecting conception rate in artificially inseminated cattle under farmers' condition in Ethiopia. *Journal of Cell and Animal Biology* 5(16):334-338.
- Wytze B, Dawit M, Binyam K, Mahlet Y, Jan van der L (2012). The Major Ethiopian Milk sheds. An assessment of development potential Milk value chain, stakeholders, production potential, market potential, and possible intervention areas. Wageningen University and SNV Ethiopia.
- Zerihun B, Malede B, Tewodros F (2013). Assessment on Problems Associated with Artificial Insemination Services in West Gojjam Zone, Ethiopia. *Advances in Biological Research* 7(2):59-66.

Related Journals:

