

**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF AGRICULTURE AND ANIMAL SCIENCES

DEPARTMENT OF ANIMAL PRODUCTION AND MANAGEMENT

***AZOLLA PINNATA*, A POTENTIAL PROTEIN INGREDIENT FOR TURKEY
PRODUCTION**

BY

SEJJONGO IVAN

BU/UP/2019/2560

Sejjongoivan@gmail.com

**A RESEARCH DISSERTATION SUBMITTED TO THE FACULTY OF
AGRICULTURE AND ANIMAL SCIENCES IN PARTIAL FULFILLMENT OF
REQUIREMENTS FOR THE AWARD OF A BACHELOR'S DEGREE IN ANIMAL
PRODUCTION AND MANAGEMENT OF BUSITEMA UNIVERSITY**

MARCH, 2024

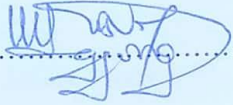
DECLARATION

DECLARATION

I, Sejjongo Ivan, hereby declare that this dissertation is my original work to the best of my knowledge and it has never been submitted to any University for any award.

NAME: **SEJJONGO IVAN**

REGISTRATION NUMBER: **BU/UP/2020/2560**

Sign..........Date. 18/3/24.....

APPROVAL

APPROVAL

The entire work relating to this research dissertation development, implementation, and report writing been done by Sejjongo Ivan with the supervision of Mr Ongom Isaac and has met all the necessary Busitema University guidelines for research, I, therefore, approve it accurate for submission to the Department of Animal Production and Management of Busitema University.

Signature:.....Isaac Ongom.....Date.....18/03/2024.....

E-mail:ongomisaacwarren@gmail.com

Research supervisor

Department of Animal Production and Management

Faculty of Agriculture and Animal Sciences

Busitema University, Arapai campus

P.O Box, 236 Tororo, Uganda.

DEDICATION

This work is dedicated to me, my wife Yeko Doreen, my son Sejjongo Jythan Israel and my daughter Nakubulwa Ivanna Maria who have supported me in all aspects of life. I also dedicate it to my 5 (Five) siblings as a sign of encouragement for academic enhancement and my mother Nalubanga Lovisa, for encouraging me during the course.

ACKNOWLEDGEMENT

With utmost sincerity and profound gladness, I express my appreciation to all lecturers in the Department of Animal Production and Management, Faculty of Agriculture and Animal Sciences of Busitema University, I would like to specifically accord my gratefulness to Mr. Ongom Isaac for his ceaseless dedication in offering guidance to me right from development of a befitting academic proposal, research activities and eventual buildup and production of this book

Equally, my special acknowledgement goes to Professor Olila Deo and Dr. Muyinda Robert, for their support in making some corrections in my write up before being cleared for data collection. I also extend my gratitude to Mr. Magumbye Joel, animal production officer for his support to me during and after data collection.

I also send my sincere thanks to Bugiri district Administration for accepting my request to carry out my research, not forgetting my course mates with whom I joined efforts to overcome challenges during the research process.

ABBREVIATIONS

FAO	Food and agriculture organization
NSP	Nonstarch polysaccharides
SFRB	Scavenging feed resource base
ANOVA	Analysis of Variance
EAA	essential amino acid
A.pinnata	Azolla pinnata
DM	Dry matter
FCR	Feed conversion ratio
PER	Protein Efficiency Ratio

TABLE OF CONTENTS

DECLARATION	i
APPROVAL	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
ABBREVIATIONS	v
ABSTRACT	ix
CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
1.2 Problem statement	2
1.2. Objectives of the study	3
General objective	3
Specific objectives	3
1.1. Research questions	3
1.4. Significance of the study	4
1.5. Justification of the study	4
1.6. Scope of study	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1. Poultry feeding resources	5
2.1.1 Fish meal	5
2.2. Constrains of feeding and feed supplements	6
2.3. Origin, distribution and classification of Azolla pinnata.	6
2.4. Significance of Azolla pinnata	6
2.5. Significance of Azolla pinnata as a meal to turkey	6
2.6. Research gaps	7
CHAPTER THREE: RESEARCH METHODOLOGY	8
3.1. Study area	8
3.2. Research design	8
3.3. Collection and storage of Azolla	8
3.4. Proximate composition	8
3.4.1 Protein Efficiency Ratio (PER)	8
3.5. Data collection	9
a.) Moisture content analysis:	9
b.) Crude protein analysis:	9
c.) Fat analysis:	9

3.6. Experimental site and design	10
3.6.1. Sample size determination	10
3.6.2. Experimental diets	11
3.7. Data management and analysis	11
3.7.1. Analysis of experimental results	11
3.8. Data presentation	11
3.9. Statistical analysis	12
3.10. Data quality control	12
3.11. Ethical consideration:.....	12
3.12. Environmental considerations:.....	12
3.13. Gender Consideration	12
3.14. Anticipated limitations.....	12
CHAPTER FOUR: RESULTS	13
4.1. Table 1: showing proximate analysis of sun dried Azolla meal	13
4.2. Ingredient composition of experimental turkey diets	13
Table 2: showing feed ingredients with their ratios of different treatment.	14
4.3. Performance of turkeys:	14
Table 3: effect of sun dried <i>azolla pinnata</i> meal incorporation on weekly weight gain, daily weight gain, feed intake and feed conversion rate in turkeys.....	15
Table: 4 showing T test for body weight gain	15
Table: 5 showing T test for Feed intake	16
There was no significant difference in feed intake among the treatment groups during the 4 weeks period of the experiment	16
Table 6: showing T test for FCR.....	16
CHAPTER FIVE: DISCUSSIONS OF RESULTS.....	18
Body weight	18
Feed intake.....	19
Feed conversion ratio	19
CHAPTER SIX: CONCLUSION AND RECOMMENDATION.....	20
6.1 Conclusion.....	20
6.2 Recommendations	20
REFERENCES	21
APPENDICES	27
Appendix: 1: map of Bugiri district	27
Appendix: 2:kibimba rice field	28
Azollapinnata	29

Sun drying of azollapinnata..... 30
Appendix 1a Raw data of results 31
Appendix: 3 weighing of turkeys..... 32

ABSTRACT

Background and Aim: The poultry industry is one of the most profitable businesses of agriculture in Uganda as it provides nutritious meat and eggs for human consumption within the shortest possible time. The most important constraint to poultry production is the inadequate feed resources and high costs of feeds yet the industry only thrives with adequate and quality feed resource. Hence, the study was carried out in Bugiri district located in Eastern Uganda and focused on the nutritive content of *Azollapinnata* and compared the growth performance of turkeys fed on *Azollapinnata* and silver fish meal protein

Materials and Methods: Harvested *Azolla pinnata* was washed thoroughly well in clean water, weighed and dried for 3 days. Dried *Azolla pinnata* was then collected, packed in air tight bags and stored for chemical analysis. A total of 10, 8-week-old turkey poults were divided into two treatment groups (5 poults each group). The poults were weighed individually, and distributed randomly on uniform body weight basis in the treatment groups. The birds were housed, water was offered ad libitum. The birds of the control group (T1) were fed a basal diet (22% CP and 3000 Kcal ME/kg), while the other group (T2) were fed on basal diet replaced by dry *Azollapinnata* powder on DM basis.

Results: The dry matter (DM) content of sun dried *Azollapinnata* meal was 91.64 per cent. It contained 8.36% total moisture, 29.51% protein and 15.49% crude fat.

Conclusion: The proximate analysis indicated that the sun dried *Azolla pinnata* is a good source of crude protein and could be used as a potential alternative protein source in turkey diets. The study indicated that *Azolla pinnata* could be safely included at 7.75% replacing fish meal without any adverse effect.

CHAPTER ONE: INTRODUCTION

1.1 Background

Being a low developed country, Uganda is poverty stricken. Therefore, among the sectors where emphasis is put is agriculture. To alleviate the problem of poverty and as well provide food to the masses and reach middle income status, agriculture, particularly livestock production is handy to that cause. The poultry sector is among the fastest growing and most flexible livestock sector (Parisi *et al.*, 2020). Ugandan poultry production is predicted to see an increase from 70500 metric tons in 2021 to reach 76000 metric tons by 2026, showing an average yearly increase of 1.2%. Improved genetics in meat and egg strains, elaborated fundamentals of nutrition plus improvement in control of diseases will crucially affect this growth (Ferreira *et al.*, 2019; Sugiharto, 2022).

Feed is an extremely crucial component in poultry production and accounts for approximately more than 70% of the overall costs in production (Macambira *et al.*, 2022). Availability of low-priced feed, that is of high quality is critical to sustain profitability and competitiveness of the sector (Liaqat *et al.*, 2016).

The available feed resources majorly include the scavenging feed resource base (SFRB) for rural smallholder farms. These include worms, plant material, insects, seeds, kitchen left overs and others. This is inadequate and with varying nutritive value (Lamaro, 2018). Commercial farms under intensive system use cotton seed cake, soy bean, fish meal as protein supplements.

The most important constraint of poultry production is the inadequate feed resources and high costs of feeds yet the industry only thrives with adequate and quality feed resources (Zone & Yirgu, 2017).

Traditionally, in Uganda fishmeal, soybean, oilseeds such as sunflower, groundnuts and blood meal from abattoirs, have been the major protein feed sources of choice for the poultry industry (Gadzirayi *et al.*, 2012).. Oilseed cakes and soybean are usually scarce due to their being seasonal which makes them a rarity and expensive in some times of the year (Gadzirayi *et al.*, 2012). Furthermore, oilseed cakes contain very much anti-nutritional factors hence cannot be solely used as protein sources (Ramírez *et al.*, 2021). Blood meal though is a good protein source, it is hard to collect sufficient volumes and the process involved is tedious. On the other hand, fishmeal and soybean are extensively

REFERENCES

- ACAF. (2001). Advisory Committee on Animal Feedingsuffs the Use of Fish Meal in Animal Feeds. *Food Standards Agency, February*, 6.
- Acharya, P., Mohanty, G. P., Pradhan, C. R., Mishra, S. K., Beura, N. C., & Moharana, B. (2015). Exploring the effects of inclusion of dietary fresh Azolla on the performance of White Pekin broiler ducks. *Veterinary World*, 8(11), 1293–1299. <https://doi.org/10.14202/vetworld.2015.1293-1299>
- Clement Ebenezer Henry, A., Lurthu Reetha, T., Paramasivam, A., & Mehala, C. (2017). Effect of Azolla supplementation on production performance of Nandanam-II Turkey growers. *Indian Veterinary Journal*, 94(2), 28–30.
- Coudert, E., Baéza, E., & Berri, C. (2020). Use of algae in poultry production: a review. *World's Poultry Science Journal*, 76(4), 767–786. <https://doi.org/10.1080/00439339.2020.1830012>
- Dolberg, F. (2003). *Poultry production for livelihood improvement and poverty alleviation. 2005*, 1–26.
- Easterby-Smith, M., Thrope, R., Jackson, P., Thorpe, R., & Jackson, P. (2013). Management research. In *Sage*. <https://doi.org/10.1097/01.brs.0000207258.80129.03>
- El Naggat, S., & El-Mesery, H. S. (2022). Azolla pinnata as unconventional feeds for ruminant feeding. *Bulletin of the National Research Centre*, 46(1). <https://doi.org/10.1186/s42269-022-00752-w>
- Famous, M., & Islam, O. (2019). *Feeding and Management System of Turkey in the Sylhet Region, Bangladesh. September*. <https://doi.org/10.17582/journal.vsr/2019/5.2.58.65>
- Feed, I. (n.d.). *Fishmeal for Fishmeal for poultry Benefits of fishmeal in POULTRY*. 3–8.
- Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*. <https://doi.org/10.1007/s10654-016-0149-3>
- Hydrilla, H., & Range, N. (2021). *Ecological Risk Screening Summary 1 Native Range and Status in*

- the United States Status in the United States. November 2020, 1–26.*
- Jaouedi, O., & Jemmali, M. B. E. N. L. B. (2022). *Azolla : Uses , role and Effect in poultry nutrition. 15(11), 8–12. <https://doi.org/10.9790/2380-1511010812>*
- Khursheed, I., Masud, S., Khan, A., Khan, N., Kour, S., Dua, S., & Khursheed, I. (2019). Proximate evaluation of *Azolla pinnata* as sustainable feed supplement for poultry. *Journal of Pharmacognosy and Phytochemistry, 8(3), 3157–3160.*
- Kiel, H., Berichterstatter, S. E., & Berichterstatter, S. Z. (2011). *RAPSEED PROTEIN PRODUCTS AS FISH MEAL.*
- Kumar, G., & Chander, H. (2017). A Study on the Potential of *Azolla pinnata* as Livestock Feed Supplement for Climate Change Adaptation and Mitigation. *Asian Journal of Advanced Basic Sciences, 5(2), 65–68.*
- Lamaro, M. (2018). *Review on Available Feed Resources and Feeding Practice of Village Chicken : Ethiopia. 02(06), 223–228.*
- Lines, B. U. T. H. (n.d.). *Feeding Guidelines for FEEDING GUIDELINES FOR NICHOLA SAND B. U. T. HEAVY LINES.*
- MAAIF. (2005). *The national animal feeds policy. March, 8–17.*
- Miles, R. D., & Chapman, F. A. (2021). *The Benefits of Fish Meal in Aquaculture Diets 1 Protein Quality of Fishmeal Benefits of Fishmeal Incorporated into Fish Diets. 1–7.*
- Rashad, S. (2021). An overview on the aquatic fern *azolla* spp. As a sustainable source of nutrients and bioactive compounds with resourceful applications. *Egyptian Journal of Aquatic Biology and Fisheries, 25(1), 775–782. <https://doi.org/10.21608/EJABF.2021.150205>*
- Raymond, J. K., Onyango, A. N., & Onyango, C. A. (2020). *Proximate Composition and Mineral Contents of Farmed and Wild Fish in Kenya. 9(3), 53–62. <https://doi.org/10.5539/jfr.v9n3p53>*
- Shukla, M., Bhattacharyya, A., Shukla, P. K., Roy, D., Yadav, B., & Sirohi, R. (2018). *Effect of Azolla feeding on the growth , feed conversion ratio , blood biochemical attributes and immune*

- competence traits of growing turkeys*. 11, 459–463.
<https://doi.org/10.14202/vetworld.2018.459-463>
- StataCorp. (2013). Stata Statistical software. In *Stata: Release 13*.
<https://doi.org/10.1016/j.dss.2011.12.012>
- Tainika, B., & Duman, M. (2019). *Poultry Production in Uganda : Challenges and Opportunities*.
Poultry Production in Uganda : Challenges and Opportunities. December.
- Tawasoli, M. J., Kahate, P. A., Shelke, R. R., Chavan, S. D., Shegokar, S. R., & Nage, S. P. (2020).
Performance of Azolla (*Azolla pinnata*) Meal on Body Weight Gain and Dressing Percentage of
Vanraja Poultry Birds. *International Journal of Current Microbiology and Applied Sciences*,
9(7), 4001–4008. <https://doi.org/10.20546/ijcmas.2020.907.470>
- UBoS. (2009). The Republic of Uganda National Livestock Census Report. *Statistics*, 256.
https://www.ubos.org/wp-content/uploads/publications/05_2019THE_NATIONAL_LIVESTOCK_CENSUS_REPORT_2008.pdf
- Zone, S., & Yirgu, T. (2017). *Poultry Feed Resources and Coping Mechanisms of Challenges in*.
60(May), 77–86.
- ACAF. (2001). Advisory Committee on Animal Feedingsuffs the Use of Fish Meal in Animal
Feeds. *Food Standards Agency, February*, 6.
- Acharya, P., Mohanty, G. P., Pradhan, C. R., Mishra, S. K., Beura, N. C., & Moharana, B. (2015).
Exploring the effects of inclusion of dietary fresh Azolla on the performance of White Pekin
broiler ducks. *Veterinary World*, 8(11), 1293–1299.
<https://doi.org/10.14202/vetworld.2015.1293-1299>
- Clement Ebenezer Henry, A., Lurthu Reetha, T., Paramasivam, A., & Mehala, C. (2017). Effect of
Azolla supplementation on production performance of Nandanam-II Turkey growers. *Indian
Veterinary Journal*, 94(2), 28–30.
- Coudert, E., Baéza, E., & Berri, C. (2020). Use of algae in poultry production: a review. *World's*

- Poultry Science Journal*, 76(4), 767–786. <https://doi.org/10.1080/00439339.2020.1830012>
- Dolberg, F. (2003). *Poultry production for livelihood improvement and poverty alleviation*. 2005, 1–26.
- Easterby-Smith, M., Thrope, R., Jackson, P., Thorpe, R., & Jackson, P. (2013). Management research. In *Sage*. <https://doi.org/10.1097/01.brs.0000207258.80129.03>
- El Naggat, S., & El-Mesery, H. S. (2022). Azolla pinnata as unconventional feeds for ruminant feeding. *Bulletin of the National Research Centre*, 46(1). <https://doi.org/10.1186/s42269-022-00752-w>
- Famous, M., & Islam, O. (2019). *Feeding and Management System of Turkey in the Sylhet Region, Bangladesh*. September. <https://doi.org/10.17582/journal.vsr/2019/5.2.58.65>
- Greenland, S., Senn, S. J., Rothman, K. J., Carlin, J. B., Poole, C., Goodman, S. N., & Altman, D. G. (2016). Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*. <https://doi.org/10.1007/s10654-016-0149-3>
- Hydrilla, H., & Range, N. (2021). *Ecological Risk Screening Summary 1 Native Range and Status in the United States Status in the United States*. November 2020, 1–26.
- Jaouedi, O., & Jemmali, M. B. E. N. L. B. (2022). Azolla : Uses , role and Effect in poultry nutrition. 15(11), 8–12. <https://doi.org/10.9790/2380-1511010812>
- Khursheed, I., Masud, S., Khan, A., Khan, N., Kour, S., Dua, S., & Khursheed, I. (2019). Proximate evaluation of Azolla pinnata as sustainable feed supplement for poultry. *Journal of Pharmacognosy and Phytochemistry*, 8(3), 3157–3160.
- Kiel, H., Berichterstatter, S. E., & Berichterstatter, S. Z. (2011). *RAPSEED PROTEIN PRODUCTS AS FISH MEAL*.
- Kumar, G., & Chander, H. (2017). A Study on the Potential of Azolla pinnata as Livestock Feed Supplement for Climate Change Adaptation and Mitigation. *Asian Journal of Advanced Basic Sciences*, 5(2), 65–68.

- Lamaro, M. (2018). *Review on Available Feed Resources and Feeding Practice of Village Chicken : Ethiopia*. 02(06), 223–228.
- Lines, B. U. T. H. (n.d.). *Feeding Guidelines for FEEDING GUIDELINES FOR NICHOLAS AND B. U. T. HEAVY LINES*.
- MAAIF. (2005). *The national animal feeds policy*. March, 8–17.
- Miles, R. D., & Chapman, F. A. (2021). *The Benefits of Fish Meal in Aquaculture Diets I Protein Quality of Fishmeal Benefits of Fishmeal Incorporated into Fish Diets*. 1–7.
- Rashad, S. (2021). An overview on the aquatic fern azolla spp. As a sustainable source of nutrients and bioactive compounds with resourceful applications. *Egyptian Journal of Aquatic Biology and Fisheries*, 25(1), 775–782. <https://doi.org/10.21608/EJABF.2021.150205>
- Raymond, J. K., Onyango, A. N., & Onyango, C. A. (2020). *Proximate Composition and Mineral Contents of Farmed and Wild Fish in Kenya*. 9(3), 53–62. <https://doi.org/10.5539/jfr.v9n3p53>
- Shukla, M., Bhattacharyya, A., Shukla, P. K., Roy, D., Yadav, B., & Sirohi, R. (2018). *Effect of Azolla feeding on the growth , feed conversion ratio , blood biochemical attributes and immune competence traits of growing turkeys*. 11, 459–463. <https://doi.org/10.14202/vetworld.2018.459-463>
- StataCorp. (2013). Stata Statistical software. In *Stata: Release 13*. <https://doi.org/10.1016/j.dss.2011.12.012>
- Tainika, B., & Duman, M. (2019). *Poultry Production in Uganda : Challenges and Opportunities Poultry Production in Uganda : Challenges and Opportunities*. December.
- Tawasoli, M. J., Kahate, P. A., Shelke, R. R., Chavan, S. D., Shegokar, S. R., & Nage, S. P. (2020). Performance of Azolla (*Azolla pinnata*) Meal on Body Weight Gain and Dressing Percentage of Vanraja Poultry Birds. *International Journal of Current Microbiology and Applied Sciences*, 9(7), 4001–4008. <https://doi.org/10.20546/ijcmas.2020.907.470>
- UBoS. (2009). The Republic of Uganda National Livestock Census Report. *Statistics*, 256.

https://www.ubos.org/wp-content/uploads/publications/05_2019THE_NATIONAL_LIVESTOCK_CENSUS_REPORT_2008.pdf

Zone, S., & Yirgu, T. (2017). *Poultry Feed Resources and Coping Mechanisms of Challenges in*. 60(May), 77–86.