

THE UNIVERSITY OF ZAMBIA

USE OF ANTHILL SOIL AS A SOURCE OF IRON IN PIGLETS

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**A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF AGRICULTURAL
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DECLARATION

This research project report has been compiled by myself and has not been accepted in any previous application for a degree. The work which this report records has been done by me and all sources of information have been acknowledged by means of references.

MFULA PRISCA C

MAY, 2011

DEDICATION

I would like to dedicate this project report to my family, especially my mother Anastasia Chanda Mfula and my father Lickman Chipepo Mfula for their ever loving support.

ABSTRACT

A study was done to evaluate the use of anthill soil as a source of iron in piglets at the University of Zambia's field station. One litter, comprising 10 piglets was given anthill soil as a source of iron (SOIL) while the control litter (11 piglets) was given the conventional iron injection (CONT). Growth performance and haematological parameters (packed cell volume and haemoglobin content) were measured over a period of six weeks. The results showed that there were no significant differences in the parameters measured between the two litters. However, in absolute terms, the SOIL piglets had slightly lower values of weekly weights and haemoglobin content than the CONT piglets. Further, the haemoglobin below the recommended 9.0 g/100 ml to avoid anaemia. It is concluded that while soil can be used as source of iron, the present results are not conclusive. Further research is recommended.

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TABLE OF CONTENT

DECLARATION.....	iii
DEDICATION	iv
ABSTRACT.....	v
ACKNOWLEDGEMENTS	vi
TABLE OF CONTENT	vii
LIST OF TABLES	ix
LIST OF FIGURES.....	x
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Value of pigs.....	1
1.2 Pig production and consumption in Zambia.....	1
1.3 Objectives.....	2
CHAPTER TWO.....	3
LITERATURE REVIEW	3
2.1 Value of iron in Piglets.....	3
2.2 Iron deficiency (Anaemia).....	4
2.3 Relevance of iron.....	4
2.4 Sources of iron.....	4
CHAPTER THREE	6
MATERIALS AND METHODS	6
3.1 Animals	6
3.2 Treatments.....	6
3.3 Feeding	7
3.4 Measurement of growth performance of piglets.....	7
3.5 Blood sampling.....	9
3.6 Laboratory analysis	9
3.6.1 Haemoglobin determination	9

3.6.2 Determination of packed cell volume.....	9
3.7 Statistical analysis	10
CHAPTER FOUR	11
RESULTS AND DISCUSSION.....	11
4.1 Growth performance analysis.....	11
4.2 Haemoglobin content and packed cell volume (PCV)	13
4.3 Implication of results.....	16
CHAPTER FIVE	17
CONCLUSION AND RECOMMENDATION	17
5.1 Conclusion.....	17
5.2 Recommendation.....	17
REFERENCES	18
APPENDIX	20

LIST OF TABLES

Table 1	Composition of piglet starter.....	7
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LIST OF FIGURES

Figure 1	A piglet being weighed in a plastic bucket on an electronic scale at field station (School of Agricultural Sciences Department of Animal science).....	8
Figure 2	Growth performance of piglets on different sources of iron.....	12
Figure 3	Packed cell volume of blood of different sources of iron.....	14
Figure 4	Packed cell volume of blood of different sources of iron.....	15

CHAPTER ONE

INTRODUCTION

1.1 Value of pigs

Livestock production forms an integral part of Agricultural activities of small holder farmers in Zambia. Pig production is a major agricultural activity in small holder operations especially in the peri urban areas. It is a growing source of animal protein and an important income generation activity both in the peri urban and rural areas. According to Murphy et al. (1997), among the various livestock species, piggery is the most potential source of meat production and more efficient feed converter after broilers. Moreover piglets are highly prolific with a shorter generation interval. A sow is able to breed as early as 8-9 months of age and can farrow twice a year, producing at least 6-12 piglets per farrowing. In terms of meat yield, pigs have a dressing percentage ranging from 65-80%, compared to other livestock species whose dressing percentage may not exceed 65%. Additional advantage of pigs is their ability to give quick returns since the marketable weight of fatteners can be achieved within a period of 6-8 months.

1.2 Pig production and consumption in Zambia

Although livestock numbers are not readily available, various government and research documents put the number of pigs in the country at about 500 000 of which 90% are under small holder farmers. Undoubtedly, this group of farmers plays a significant role in the pig industry.

Smallholder farmers are however, faced with a number of challenges including limited skill of pig management, nutritional supplements and high cost of drugs. one of the major challenges related to costs of nutritional supplements is that of provision of iron to piglets.

Piglets are born with low iron levels which need to be boosted within a week of being born. Unfortunately the sow's milk is very limiting in iron. This means the piglets need to get this

from an external force. If iron is not given to the piglets, they become anaemic and die (Miller et al, 1997). It has also been observed that if piglets do not receive adequate amount of iron, they become sickly and do not grow or develop as they should. The normal practice of boosting iron levels in newborn piglets is through giving iron injection. In rural areas, however, the challenge is the availability of this source of iron as well as its cost. Alternative sources of iron under smallholder management must, therefore, be a major consideration.

In Zambia anthill soil is readily available and this soil presumably contains levels of iron which may meet the requirements for piglets. However, the information on the use of this soil is scanty. Further, this is not a regular management practice in pig production in Zambia.

1.3 Objectives

Given the above background, the present study was carried out with the following objectives:

- To investigate the growth performance of new born piglets given anthill soil as a source of iron during the first six weeks of their life; and
- To measure the haemoglobin content and packed cell volume of blood as a way of evaluating the effectiveness of the iron source.

CHAPTER TWO

LITERATURE REVIEW

2.1 Value of iron in Piglets

Humans have for a long time known that iron plays an important role in health and disease for a considerable period of time (Loosli, 1978). In fact, Bryan (1931) documented therapeutic uses of iron as far back as 500 BC.

Due to the minimum concentration of iron in the sow's milk (1 mg /liter), neonatal pigs reared in confinement require supplemental iron in order to overcome the susceptibility to anaemia (Kerelin and Sirotinia, 1976). According to Alexander and Murrhead (1997), piglets are bound to develop anaemia within the first few weeks of life. Miller et al.(1997) reported that during the first 4 weeks of life, the body weight increases by up to fivefold and the dietary requirement of iron during this period is 7 mg/day but only 1 mg /day can be supplied by the sow's milk. Pigs not supplemented with iron while dependent on sows milk quickly develop iron deficiency (Venn et al, 1947). However piglets born in outdoor system do not develop anaemia due to constant contact with soil which is a rich source of iron; this ensures enough iron ingested to cover for needs of newborn piglets. To ensure protection from parasitic infestation, soils need to be sterilized (Alexander and Murrhead, 1997). In the study by Wahlsatron and Jubl 1960, maximum hemoglobin levels were produced in neonates at 14 days of age when supplemented with either 100 or 150 mg iron dextran at birth. Zimmerman et al. (1959) found that maximum growth rates were acquired through supplementation of 100 mg in form of injectable iron dextran to pigs weaned at 3 weeks of age. According to Amine et al.(1972), the bioavailability of oral iron depends greatly on the health status of the animals.

2.2 Iron deficiency (Anaemia)

According to O'Dell (1989) anaemia, an iron deficiency disease, causes shivering, loss of appetite, inactivity, paleness and scouring among piglets. Webster et al, (2009) reported anaemia to be responsible for at least 10 % pre weaning deaths in piglet litters not given any iron source. Braasch (1891) was credited with being the first to describe anemia in nursing pigs that were being reared in confinement in Germany. However he did not adequately study the anaemia with iron deficiency but instead with management. The first to link anemia in nursing pigs with iron deficiency were Mc Gowan and Crichton (1924). The first to realize this in the United States were Hart et al, (1929) who showed that anemia could be prevented by orally supplementing the ferrous or ferric sulphate. Factors which compound susceptibility of piglets to anemia include very low stores at birth, absence of polycythemia of birth common to other animal, (particularly low levels of iron in sow's milk) and very rapid growth rate compared to other species.

According to Hannan, (1971) the need to provide the piglets with adequate amount of iron before weaning therefore is imperative because the sow's milk alone will not meet the iron requirement of the rapid growth and expanding blood volume.

2.3 Relevance of iron

Murphy et al. (1997) reported that iron is an integral part of hemoglobin and myoglobin, both of which play a central role in the exchange of oxygen and carbon dioxide between the blood and muscle. Iron also plays an important role in the function of many enzymes including those in the Krebs cycle of energy metabolism. As such the role of iron in the organism can only be described as very important, if not indispensable. According to Karelin and Sirotini (1976), iron also plays a role in the formation of haemoglobin and enzymes which is its primary function. O'Dell, (1989) noted that cell nuclear regulation is another important role of iron. The chromatin of the nucleus contains iron which takes an active part in the functioning of the nuclei. Additionally iron helps in many aspects such as metabolic reactions, differentiation and also regulation of cell growth.

2.4 Sources of iron

According to Thoren (1975), piglets are injected in the muscle of the neck or ham with up to 20 mg iron as iron dextran. This is, however, stressful and painful; poor iron injection techniques

may cause considerable trauma to the muscle, creating abscesses and lead to down grading of the carcass quality. Alexander and Murrhead (1997) reported that sterilized soil can be used in the creep feed. However this can also present some problems such as variable intake of soil, high labour requirement and the risk of transferring parasites and diseases. Murphy et al. , (1997) also reported that rooting material has been used as a source of iron successfully. However the technique of preparing rooting material is laborious and requires a lot of time thus, diligence of application. A further study by Karelin and Sirotinia (1976) revealed that iron rich paste placed in the mouth of new born piglets. Pastes are also enriched with glucose, lipid, immunoglobulin vitamin and other minerals can also be effective. However necessary precautions must be taken to ensure piglets swallow the paste.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Animals

The study was conducted at the university of Zambia' s Department of Animal Science field station, involving two litters of piglets. One litter of 11 piglets was given iron injection within three days following birth (control) while the other litter of 10 piglets was provided with treated anthill soil throughout the experimental period.

3.2 Treatments

The control piglets (CONT), were given 200 mg iron dextran injection on day 3 following farrowing. With regard to the litter on anthill soil (SOIL), the soil was initially collected from three anthills (designated A ,B and C) from the university of Zambia field station. The samples were analyzed at the Soil Science laboratory for concentration of iron; the concentrations were : Sample A=2.9 mg/kg ,B=3.02 mg/kg and C =2.64 mg/kg. Sample B was chosen for use in the trial. A 20 kg soil sample was then collected and sterilized at 90 degrees Celsius for 30 minutes as a control measure against parasitic infection.

3.3 Feeding

Creep feed was formulated for the piglets as presented in Table 1

Table 1 : Composition of piglet starter

Ingredient	Starter ration
Maize meal	63.87
Soya cake	32.00
Dicalcium phosphate	1.40
Limestone	1.60
Salt	0.35
Methionine	0.15
Lysine	0.13
Premix	0.5

At the age of 2 weeks, 0.5 kg of finely ground soil was added to the creep feed for the SOIL piglets and increase by 0.15 weekly. The creep feed for the CONT piglets did not contain any soil. Both litters received their feed twice daily. The Piglets health was monitored during the course of the research. Routine management practices included identification, tail docking and castration. The piglets were also treated of diarrhoea using intramuscular injection of megaject. Three piglets from the CONT group died while four mortalities were recorded from the SOIL group.

3.4 Measurement of growth performance of piglets

The piglets were weighed individually at birth and every week for a period of six weeks. An electronic scale was used for the measurement. A plastic bucket was used to balance the piglet on the scale. (See figure 1).

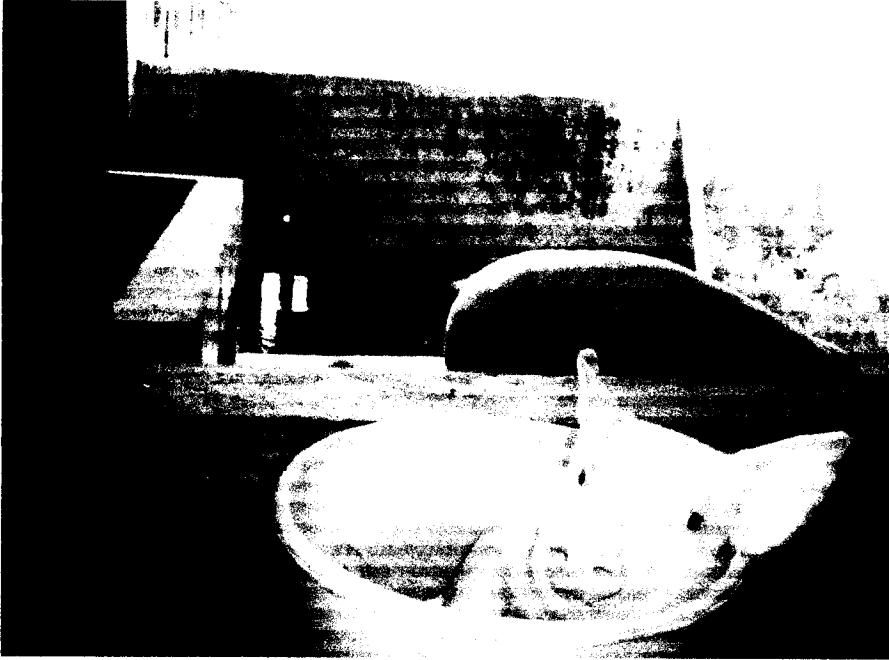


Figure I: A piglet being weighed in a plastic bucket on an electronic scale

3.5 Blood sampling

Blood Samples were collected at four specific times in six weeks period using heparinised vacutainers and hypodermal needles. The blood was collected in 5 ml vacutainers. The samples were put on ice and immediately taken to the laboratory where they were analyzed.

3.6 Laboratory analysis

3.6.1 Haemoglobin determination

Tubes graduated to the 20 cm mark were filled with 10% normal hydrochloric acid. The pipette was filled with blood to the 20 cm mark and excess blood was carefully wiped out from the outside of the pipette. The blood was then expelled into the acid. The solution was mixed with the help of the mixing rod. The mixture was allowed to stand for 5 minutes; then water was added with the dropper until the blood /acid solution matched the standard. Each moment water was added to match the standard , the content of the tube was carefully mixed by means of a glass rod supplied. On removal of the rod care was taken to ensure that there was no loss of fluid from the tube. The percentage haemoglobin was read from the graduated tube. Haemoglobin content was expressed as grams/100mls of blood. This analysis was done once for each blood samples rinsing the tubes every after use and hence 21 pairs of tubes were analyzed, 11 and 10 for CONT and SOIL respectively.

3.6.2 Determination of packed cell volume

The remainder of the blood used for haemoglobin level analysis was used in Packed cell volume determination. This method compares the volume of cells to plasma and is expressed as a percentage. In this method 21 samples were analyzed 11 and 10 for CONT and SOIL respectively as in the previous analysis. Two capillaries tubes in duplicate per blood sample were filled with blood by inserting the two capillary tubes at a goal tilted and closing the other end which is outside the blood with fingers so that blood goes in the capillary tube by capillary refill method. The end of the tubes was sealed with wax, placed in the micro haematocrit centrifuge, then closed and allow the process to run for 4 minutes. The packed cell volume of the samples was determined using the haematocrit reader.

3.7 Statistical analysis

The data for each parameter was analyzed using SAS. A t-test was used to compare the treatments at $P=0.05$.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Growth performance analysis

Results for the growth performance of piglets are presented in Figure 2. At week 3, the CONT piglets weighed 5.11 ± 1.35 kg while the SOIL piglets weighed 4.26 ± 1.24 kg ; at week 4, the weights were 5.89 ± 1.86 kg and 5.39 ± 1.36 kg, respectively. The final weights at week 6 were 10.74 ± 5.19 and 8.53 ± 4.29 kg , respectively. There were no statistical differences between the treatments at all these points although the absolute values tended to be higher for the CONT piglets than for the SOIL piglets. One contributing factor for the non- significance of the results was probably the large variation within each treatment.

Information on the growth performance in piglets given soil as a source of iron, is scanty. The present results need to be treated with caution especially given the small sample sizes and large variability of weight.

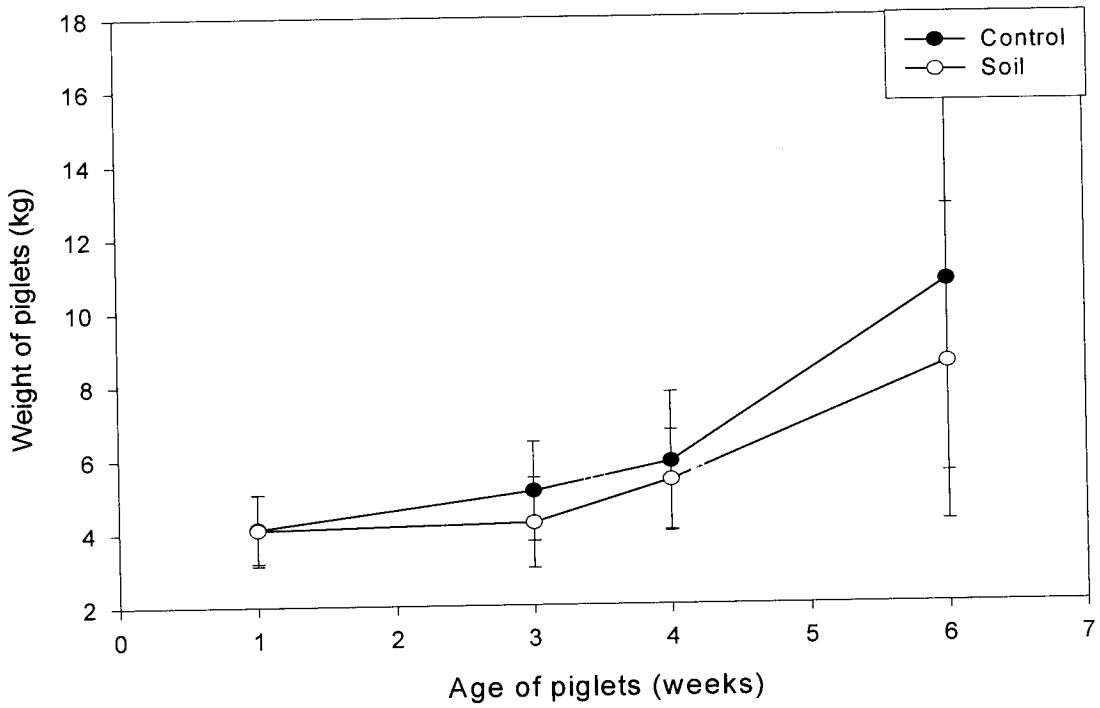


Figure 2. Growth performance of piglets on different sources of iron (CONT = injectable iron, SOIL = iron from anthill soil)

4.2 Haemoglobin content and packed cell volume (PCV)

The hemoglobin content was 13.74 ± 2.69 and 13.88 ± 2.79 g/100 ml in the CONT and SOIL piglets, respectively (Figure 3). At weeks 3, 4 and 6, the haemoglobin content dropped in both treatments. Statistically there were no differences between the two treatments but again, there was a tendency for the SOIL piglets to record lower values than CONT piglets. With regard to Packed cell volume (PCV), both treatments showed consistence over the study period (Figure 4).

Normal Haemoglobin content should be more than 9.0 g/100 ml to eliminate chances of anaemia (Daykin et al. 1982). The CONT piglets were just above this Value during the experimental period. The SOIL piglets were just below this recommended value. This may somewhat explain the growth performance observed in piglets (despite the non significance between the two groups). Murphy et al. (1997) found a positive relationship between Haemoglobin and bodyweight in piglets at ages 7, 14, 21 and 28 days. The present results appeared to be consistent with these observations.

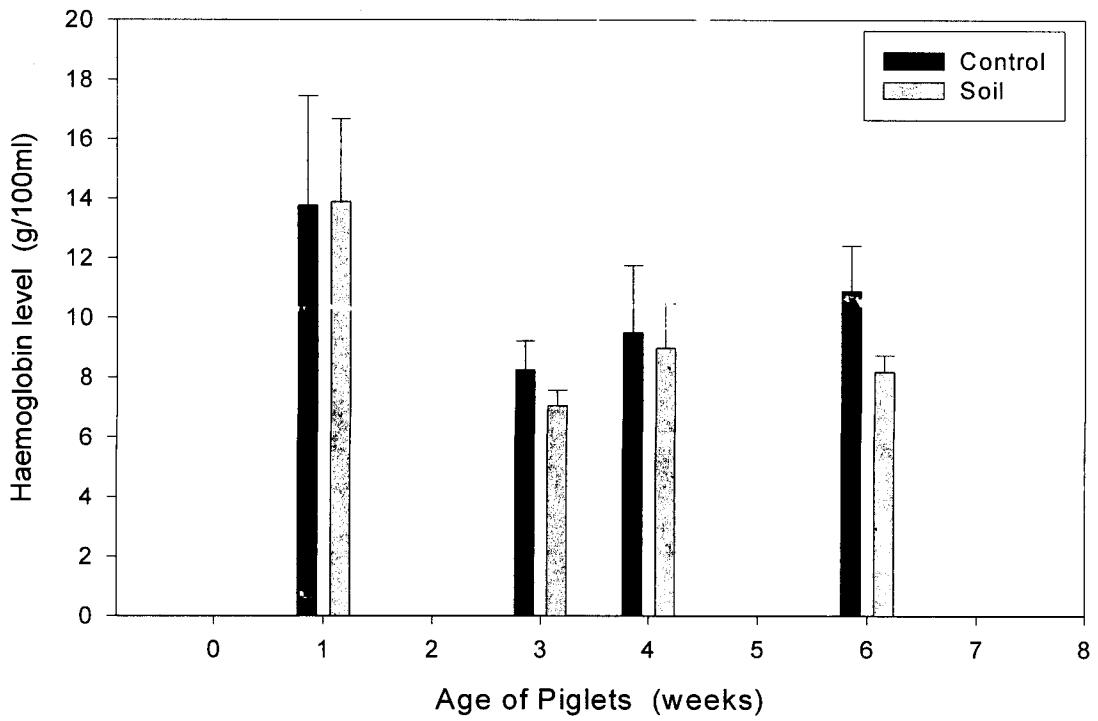


Figure 3. Haemoglobin content in blood of piglets on different sources of iron(CONT=Iron injection; SOIL= Iron in anthill soil)

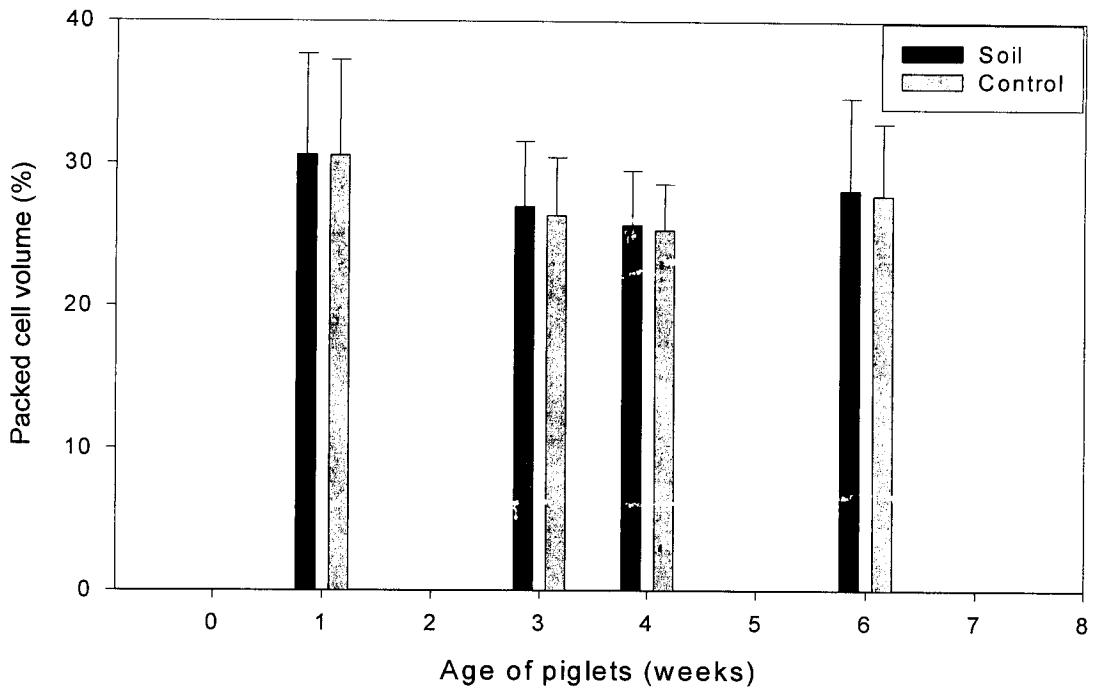


Figure 4. Packed cell volume of blood of piglets on different sources of iron : (CONT = injectable iron; SOIL = iron from anthill soil)

4.3 Implication of results

While soil can be used as a source of iron for piglets the present results indicated that in absolute terms, the growth performance and haematological parameters measured were slightly lower in the piglets given anthill soil compared to those on the conventional iron injection. In particular, the Haemoglobin content being below 9 g/100ml in the SOIL piglets indicated that these piglets were more prone to suffering from anaemia compared to the CONT piglets. Perhaps the type of soil or amount of soil given needs to be re-examined.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the study it was observed that the piglets on soil treatment had slightly lower values in all parameters measured. There were, however, no significant differences, possibly due to high standard errors. From these preliminary results, it may be concluded that soil can be used as a source of iron in piglets. However, the results are not conclusive enough to recommend to the farmers.

5.2 Recommendation

It is recommended that further research involving larger samples of piglets and different types of soil at different levels, is done.

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<http://www.essortment.com/disease-hogs-causes-symptoms-treatment-62272.html>

APPENDIX

Table I: Least square means \pm SE of weekly weights in piglets given iron injection (CONT) and anthill soil (SOIL) as a source of iron.

Week	CONT	SOIL
1	4.13 \pm 0.93	4.09 \pm 0.97
3	5.11 \pm 1.35	4.26 \pm 1.24
4	5.89 \pm 1.86	5.39 \pm 1.36
6	10.74 \pm 5.19	8.53 \pm 4.29

Table II: Least square means \pm SE of weekly measurements of blood Haemoglobin levels in piglets given iron injection (CONT) and anthill soil (SOIL) as a source of iron.

Week	CONT	SOIL
1	13.74 \pm 2.69	13.88 \pm 2.79
3	8.23 \pm 0.98	7.03 \pm 0.52
4	9.48 \pm 2.25	8.96 \pm 1.49
6	10.87 \pm 1.52	8.15 \pm 0.57

Table III: Least square means \pm SE of weekly measurements of blood packed cell volume in piglets given iron injection (CONT) and anthill soil (SOIL) as a source of iron.

Week	CONT	SOIL
1	30.54 \pm 6.71	30.60 \pm 7.07
3	26.36 \pm 4.06	27.00 \pm 4.57
4	25.33 \pm 3.24	25.70 \pm 3.80
6	27.78 \pm 5.07	28.13 \pm 6.51