Chapter one

Introduction:-

Meat and bone meal is defined as the rendered product from mammal tissues, including bone, exclusive of any added blood, hair, hooves, horns, hide trimmings, manure, stomach and rumen contents excepts in such amounts as may occur unavoidably in good processing practices. (John H. Goihal 2103). It contain a minimum 2.2% phosphorus and the calcium level not be more than 4% times the actual phosphorus level. A description of the source is applied as to whether the MBM is from pork or beef.

Meat and bone meal is a product of the rendering industry. It belongs to the group of additional protein ration since it is best when combined with other protein sources such as soya bean and fish flour. It contains about 48 -52% protein, 33 – 35 % ash, 8 – 12 % fat and 4 – 7 % moisture. Also contains considerable quantity of minerals particulariy calcium and phosphorus (Navigation search2018). It is rich source of energy and provides all the essential amino acids required for growth and egg production. The rendered meat and bone meal (MBM) is free from all pathogens including protozoa, fungi, and bacteria (Gogesh and Shihde\ 2011).

Meat and bone meal is widely used in the united states and Europe as a low cost meat for dog and cat feed, some MBM is used as ingredients in pet food but the vast majority is now used as a fossil – fuel replacement for renewable energy generation , as a fuel in cement kilns, land filling or incineration.

Meat and bone meal has primary used in the formulation of animal feed to improve the amino acid profile of the feed. Feeding of meat and bone meal to cattle is thought to have been responsible for the spread of BSE (mad cow disease). In most part in the world meat and bone meal is no longer allowed in feed for ruminant animals. However, it is still used to feed mono gastric animals (Navigation search 2018).

Nutrients contained in meat and bone meal are found in both the organic meat and the inorganic bone fractions, the latter being released at a much slower rate than the former (John H Goihal\ 2013).

Meat and bone meal back into feed:

The European commission has banned the use of meat and bone meal in animal feed. There are enough reasons for lifting this ban, but decision making in Brussels is slow (Dick Zeggers 2010). Too long the feed industry has been withheld from a cheap and valuable feed ingredient. Europe, and mainly the united kingdom in the nineties of the last century were facing a crisis when mad cow disease paralysed the animal industry. Cattle were fed ruminant remains that contained a protein (prion) that caused bovine spongiform Encephalopathy (BSE) or mad cow disease. The big problem is that people can get the BSE related and lethal creutzfeld – Jacob disease, if they eat infected beef (Dick Zeggers 2010).

❖ Objectives:-

- To Manufacture carcass meal or meat and bone meal from condemned parts in slaughter houses.

- To determine chemical composition of meat and bone meal.

- To determine the safety of meat and bone meal processed by dry-rendering method.

Chapter two

2. Literatures:-

2-1.chemical composition of meat and bone meal (MBM):

the Sterilized Meat and Bone Meal produced is the richest source of protein, essential amino acids and minerals like calcium, phosphorus etc, required for growth and egg production. Meat and bone meal is produced under the world class sanitary and phytosanitary conditions. It's free from all the pathogens including protozoa, fungi and bacteria (Gogesh and Shihde 2011). It is rich source of energy and provide all the essential amino acids.The sterilized meat and bone meal is an excellent and cheaper source of protein, calcium and phosphorus to the poultry. The rendering industry produces large quantities of meat and bone meal, A.S.A.B.E. (2006). Renderers produced 2.1million metric tons of bovine, porcine or mixed species meat and bone meal. Almost all MBM was utilized as a high protein ingredient in animal feed. Today most countries do not allow (MBM) containing any amount of ruminant tissue to be fed to ruminant animal. In a united state MBM with ruminants tissue is used in feed for non ruminant farm animals. MBM is banned from the feed of any animals that may be came human food. In EU MBM is now primarily either incinerated or used for energy content in operation such as cement plants.

In the mid-20th century meat and bone meal (MBM) was a major protein ingredient in swine diets because it supplied protein, minerals, calcium and phosphorus (John H. goihl /2013). The value of the phosphorus in meat and bone meal has been reduced with the increased use of phytase and dried distillers grains with soluble in swine diets. The effective use of MBM as a source of calcium and phosphorus is dependant an accurate assessment of the digestibility of these minerals when fed to pigs. There is variability in calcium and phosphorus percentages from different MBM sources because of different composition and processing method.

Meat and bone meal is a valuable raw material providing energy, protein, vitamins and minerals, which vary in levels, but that are very well digested by the animals. There are considerable variation nutrient specifications from company to another. Meat and bone meal is an excellent source of supplemental protein and has a well – balanced amino acid profile. Digestibility of the protein

fraction is normally quite high, ranging from 81 to 87 %. It is well suited for use in feeding mono gastric and provides not only a well balanced protein source, but also a highly available source of calcium and phosphorus. In addition to the protein (amino acids) meat and bone meal is an excellent source of calcium and phosphorus and some other minerals (K, Mg, Na, etc) (International feed2018) When using meat and bone meal as the primary supplemental protein source the minerals levels may limit it's use in some diet formulations. Meat and bone meal like with other animal products is a good source of vitamin B 12.

2-1-1.Moisture content:-

Moisture is a term to describe the amount of water remaining in meat and bone meal after it has been processed. Moisture is determined by measuring the loss in weight upon heating a sample in a drying oven at 135 C for a giving period of time. Moisture is expressed as a percentage. The low moisture content (2 – 4 %) is well accepted by pet food Microbiological control is a critical control point for rendering so low moisture will be often found in MBM but higher moisture content will increase yields and will give better income .we can observe that the focus for the analyzed samples was to lower the risk of microbiological activity (Nagy and Rivis Adrian 2014).

The moisture component of meat and bone meal after processing is ideally in the range from 3 to 6 percent. Level belowt may indicate over cooking. High level of moisture are detrimental to the quality of the meal and a maximum limit of 10 percent is set. High moisture will depress the crude protein level of the meal and increase the potential for oxidation of the fat component. It will also affect the physical characteristics of the meal and increase the possibility of micro organism growth. Gogesh and Shihde (2011) found the moisture percentage as 6 - 10 %.while the moisture % reported by Nagy and Rivis Adrian (2014). as 1.15 – 3.45% . Backa topola (2010) was found the moisture % as 9 %. While the moisture % reported by A .S.A .B.E. (2006) as 1.9 – 5.7. Dick ziggers (2010) was found the moisture % as 3 – 11.2 %.

2-1-2.Protein content:

The crude protein test is important in the trading of rendered meal as a basic measure of quality and commercial value. As rendered meals are produced from natural raw materials which can be variable, close monitoring of their protein levels is important to both producer and end users. Feed manufactures rely on minimum crude protein levels to be maintained for meals used in their formulations. There are some twenty three different amino acids required by animals in their diet for their development and growth. A number of them cannot be produced in the body and these are known as essential amino acids Examples are lysine, methionine, tryptophan, threonine and cystine. The amount of essential amino acids available in meals is there fore an important consideration in animal feed formulation, Nagy and Rivis Adrian (2014).

The Gogesh and Shihde (2011). found the protein % as 45 - 50%.While the protein % reported by Nagy and Rivis Adrian (2014). as 50 – 59 %. Backa topola ltd 2010 study was found the protein % as 45 %. The A S A B E (2006) are found the protein % as 44.6 – 62.8 %. John H. Goihle (2013) found the protein % as 42.7 – 57.2 %. Dick Ziggers (2010) was found the protein % as 49 – 52.8%. While the protein % reported by International feed (2018) as 50 %. David L Meeker study (2006) was found the protein % as 50.4 %.

2-1-3.Fat content:-

The fat content of meat and bone meal is amount of fat remaining in the product in the product after processing fat levels will vary from plant to plant depending upon raw material input and processing condition. They normally rang from around 8 -13 percent with a maximum of 15 percent.

The analysis of the fat content of meat and bone meal is usually carried out by the soxchlett extraction method using petroleum ether solvent. High levels of fat however can affect the free flowing characteristics of the meal causing handling problems which may include caking in bins and chutes excessive fat may also lead to problems with oxidative stability

Fat composition ranges from 10 % to 20 % depending on the process. a good pressing is giving low fat percentage. The developing of free fatty acid

level is typically controlled by addition of antioxidants. Nagy and Rivis Adrian (2014).

Gogesh and Shihde (2011) found the fat % as 5 – 8 %, while the fat % reported by Nagy and Rivis Adrian (2014) as 13.1 – 16.7 %, Backa topola study (2010) was found the fat % about 10%. A S A B E (2006) are found the level of fat % between 8.9 – 16 %. John H. Goihle (2013) found the fat % as 11.6 – 15.2 %. Dick Ziggers (2010) study was found the fat % as 8.5 – 14.8 %. while the fat % reported by international feed study (2018) as 6%. David L Meeker study (2006) was found the fat % as 10%.

2-1-4.Ash content:-

Ash is mainly bone residue and is therefore rich in calcium and phosphorus in the ratio of approximately 2:1 it also contains lesser amount of other animals.

The higher level of ash in MBM can be a challenge to formulate the receipt for pet food. Ash level in meat and bone meal is given by the content of calcium and phosphorus. And they are readily available. however, this level of minerals becomes problematic when formulating higher protein (more than 30 %) for the finished pet food. increasing levels of ash in MBM have not been shown to lower protein digestibility, but what is happening is decreasing. so quality of protein is decreasing because inside the protein we will find lower essential amino acids and a higher proportion of non essential amino acids and this gives a lower digestibility.

Gogesh and Shihde (2011) found the ash % as 35 – 40 % while the ash % reported by as 23 – 30 %, also the A S A B E (2006) was found the ash %as 20.7 – 39.9%. John H Goihl (2013) was found the ash % between 20.6 – 33.2 %. International feed (2018) was found the ash % as 35%.

2-1-5.Calcium and phosphorus:-

Meat and bone meal available source of available calcium, phosphorus and trace minerals for pig and poultry rations. The ratio of calcium to phosphorus is approximately to 2:1. In general meat and bone meal is sold on the basis of minimum 8 percent calcium and 4 percent phosphorus, but actual levels will vary from one renderer to another depending upon raw material input. Gogesh and Shihde (2011) found the calcium and phosphorus% as 8 - 12

%calcium and 4 – 6 % phosphorus. while the calcium and phosphorus % reported by backa topola (2010) as 12.70% calcium, 5.90%phosphorus. John H. goihl (2013) was found the calcium and phosphorus % about 5.09 - 11.03 % calcium and 2.59 - 5.26%phosphorus. While the calcium and phosphorus % reported by Dick ziggers study (2010) as 6 – 12 % calcium, 3.5 – 5 % phosphorus. International feed (2018) reported the calcium and phosphorus % as 7 – 10 %calcium, 4.5 - 6 %phosphorus. David L meeker study (2006) found the calcium and phosphorus % as 10.3 % calcium, 5.1 % phosphorus.

2-2.Meat and bone meal contamination:

2-2-1.Salmonella contamination of meat and bone meal:

Bensink (1979) found in The production of meat and bone meal from 8 rendering plants was examined for the presence of salmonellas of 164 samples of final product 114(69.5%) were contaminated with salmonellas of 65 samples, collected at various points from the production line 35 (53.8%), and of 95 samples collected from processing environment 79 (83.1%) were found to be contaminated with salmonellas . a total of 41serotypes were found with S.havana, S. eimsbuettel, S.ohio and S. Singapore being most frequently isolated. Pre-enrichment of 25g samples in buffered peptone water, followed by enrichment in mannitol selenite systine broth at 42 degrees C and muller-kauffmann tetrathionate broth at 37 degree C and plating on bismuth sulphite agar was found to yield 98.5% of the salmonella positive samples Bensink (1979).

Samah et al (2014) found the contamination level of Salmonella in MBM before rendering as (70 % - 40 % - 100 %). While the salmonella contamination percentage in MBM after rendering was absent in the all samples. While the E. coli contamination in MBM after rendering as (77x10^4 – 2x10^4 – 64x10^5).

2.2.2 E .coli contamination:

E. coli encompasses a number of strains of the bacterium known as Escherichia coli, which normally in habits the intestines of all animals, including humans (T I P S 1998). Most strains of E. coli are harmless, and in fact, are necessary for us to develop and function properly. E. coli and other bacteria provide us with many necessary vitamins. However, a few strains of E. coli are capable of causing illness in animals. E. coli infection or hemorrhagic

colitis, often causes cevere bloody diarrhea abdominal cramps, and occasional vomiting. Fever is either absent or a few grade. The illness is self-limiting and lasts for an ayerage of eight days.

Preventing feed contamination and animal infection from E. coli requires control measures at all stages of the feed production continuum. From agricultural production, to processing, manufacturing, transporting, storing, and preparation of feeds in both commercial establishments and the domestic environment. Samah et al (2014) found the contamination of E. coli in MBM before rendering as (24x10^8 – 31x10^8 – 16x10^6)

Chapter three

Material and methods:-

3-1. this study was conducted at college of animal production science and technology (in meat processing lab). This study was continued for 7 days.

3-2.Materials:

- Dissolve presto.
- Heating source.
- Axe.
- Swivel.
- A knife.
- Sensitive balance.
- large pot for heating.
- Blender (grinder).

3-3.Method:

Nine samples from shoulder – lumber and leg were brought from al kadro slaughterhouse. Kept in hygienic conditions and divided in to three groups weighing one kilogram for each sample. The first group was picked from the front leg, the second group from hind legs and the third group was picked from the lumber vertebrates region. the samples were prepared until the meat is semi-mixed (homogeneous), the sample were cooked by dry cooking. The first sample was dried by hot air oven and the other samples were dried by the sun rays, then the samples were well grinded until it became a powder, then the samples were thus ready for chemical analysis to determine the chemical composition of the samples.

50gm of each sample to determination of contamination level and the contaminant bacteria.

Analytical methods:-

a) Proximate analysis:-

The determination of moisture, crude protein , crude fat , and ash were carried out according to AOAC (2004) methods.

3-3-1.Moisture determination:-

Two grams of well-mixed samples were weight accurately in clean preheated crucible of known weight by using sensitive balance.

The uncovered sample and crucible were kept in an oven at 105℃ and let to stay overnight .the crucible was covered and transferred to a desiccator and weighed after reaching room temperature. The crucible was again heated in the oven for another two hours and was reweighed. This was repeated until constant weight was obtained.

The loss of weight was calculated as percent of sample weight and expressed as moisture content.

$$\text{Moisture \%} = \frac{\text{wt of sample before drying} - \text{wt after drying}}{\text{Wt before drying}} \times 100$$

$$\text{MC (\%)} = \frac{(W2 - W1) - (W3 - W1)}{(W2 - W1)} \times 100$$

Where:

MC = moisture content

W1 = weight of empty crucible

W2 = weight of crucible + sample

W3 = weight of crucible + dry sample

3-2-2.Crude protein (cp) determination:

Nitrogen content was determined by the semi-micro-kjeldahl digestion, distillation and titration method as described by the official methods of analysis

(AOAC, 2004). 0.2g of the sample was weighed into 100ml kjeldahl flask, then about 0.4g of the mixture catalyst (90%an hydrous sodium or potassium sulphate an 10% cupric sulphate or mercuric oxide) was added, about 3.5ml of concentrated nitrogen free sulphuric acid were added. The sample and content were heated on electric heater for 2hr. with gradual increase of heat. Till a colour less liquid was obtained. The digest was cooled then diluted and transferred to distillation unit using minimum volume of distilled water and made alkaline with 20ml of 40% aqueous NaOH solution. The ammonia was distilled in to 10ml of 2%boric acid solution plus 3-4 drops of methyl red indicator (Bromocresol green 0.5+0.1g methyl red dissolved in 100ml of 95% ethanol and the pH wad adjusted to 4.5) for 5-10 minutes. After lowering the receiving flask clear of condenser, the apparatus was steamed out for further 5 minutes till the volume of receiving flask reached from 50-75ml the distillate was then titrated with 0.02 N Hcl. The (CP) was calculated by multiplying the percent of nitrogen by protein conversion factor (N% X 6.25).

Calculation;

$$N(\%) = \frac{TIF \times N \times 14.00}{1000 \times Ws} \times 100$$

Crude protein % = N% X 6.25

Where:

TIF = ml HCL – ml blank

N = normality of HCL

14 = each ml of HCL is equivalent to 14mg nitrogen

1000 = to convert from mg to gm.

6.25 = constant factor

3-2-3.Ash determination:-

A crucible was weighed empty, then accurately 2g sample were put in it. The sample in crucible was placed in muffle furnace at 550℃ for 3 hours or more until white grey or reddish ash was obtained. The crucible was removed from furnace and place in desiccator to cool then was reweighed. The process was repeated until constant weight was obtained.

Ash content was calculated using the following equation:

$$AC\ (\%) = \frac{(W2 - W1)}{Ws} \times 100$$

Where:

AC= ash content
W1 = weight of empty crucible
W2 = weight of crucible with ash
Ws = weight of sample

3-2-4.Determination of fat (ether extract):-

A dry empty extraction flask was weighed 2g of sample was weighed and placed in filter paper, then placed in extraction thimble free from fat and covered with cotton wool .the thimble was placed in extractor (soxhelt apparatus).

Extraction was carried out for 7hr with petroleum ether (boiling point rang is 60-80C). the heat was regulated to obtain at least 15siphoning per hour. The residual ether was dried by evaporation.

The extraction flask was placed in an oven till drying was complete then cooled in a desiccator and weighed.

The fat content was calculated using the following equation:-

$$FC\ (\%) = \frac{W2 - W1}{Ws} X\ 100$$

Where:-
FC (%) = fat content
W1 = weight of extraction flask
W2 = weight of extraction flask with oil
Ws = weight of sample

3-2-5.Determination of mineral content:-

Mineral of raw and processed samples were extracted according to persons method (1981) each sample was burnt in muffle furnace at 550C.each sample was placed in a sand bath for 10 minutes after addition of 10ml of 5 N HCL. Then the solution was carefully filtered in 100ml volumetric flask and finally distilled water was added to make up to mark. The extracts were stores in bottles for further analysis.

3-2-5-1.Calcium contents:-

Calcium content was carried about 2ml of the sample extract was placed in a 50ml conical flash. Ten milliliters of distilled water were then added to the

contents in the flask. About 3-4 drops of 4N NAOH were added with small amount of meroxide indicator (0.5gm of ammonium purpurate was mixed with 100gm of powdered K2SO4) giving a pink colour. The contents of the flask were titrated with 0.1N EDTA (ethylene diamine tetra- acetic acid) until a violet colour, indicating in end point was obtained.

Calculation:

$$Ca\ (\%) = \frac{\{T.R \times N(EDTA) \times D.F \times M.wt \times 100\}}{10^{6} \times S \times 2 \times \text{valency}}$$

Where:
T.R = titration reading
N (EDTA) = normality of EDTA
D.F = dilution factor
M. wt = molecular weight of the element estimated
S = sample weight.

3-2-5-2.Phosphorous content:-

Analysis of phosphorous was carried out of Two milliliters of the extract were pippetted in to a 50ml volumetric flask. Ten milliliters of ammonium molybdate- ammonium vanadate reagent {22.5gm of (NH4) 6 MO7O24.4H2O in 400ml distilled water +1.25g ammonium vanadate in 300ml boiling +250ml conc. HNO3, then diluted to 1liter} were added the contents of flask were mixed and diluted to volume. The density of the colour was read after 30 minutes at 470nm using a colorimeter (lab system analysis – 9filters,J. mitra and bros Pvt. Ltd) a standard curve of different KH2PO4 concentration was plotted to calculate the ion phosphorous concentration.

Calculation:

$$\frac{\text{Reading curve} \times \text{ash dilution} \times 1000}{10^{6} \times \text{oven dry weight of sample}}$$

b) Method used in counting bacteria:

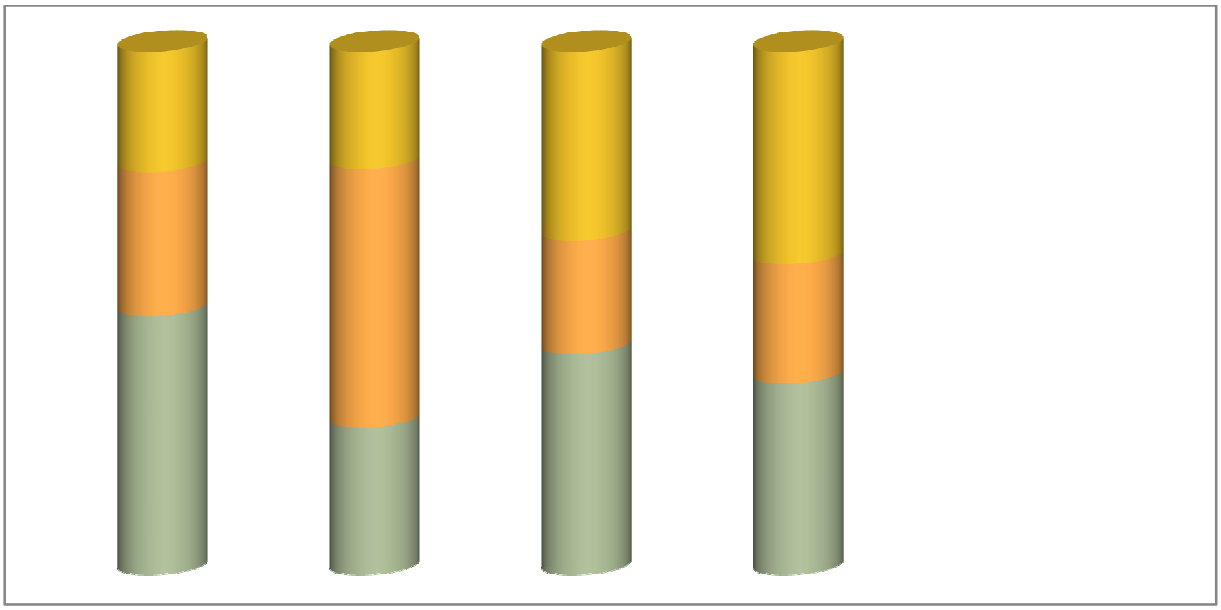
i. Viable count:

The best method for viable count is called miles and misra

❖ Miles and misra (dilution method):-

Suppose you have a culture of E.coli in a tube, we dilute the culture in sterile test tubes each containing 9ml of physiological saline – diluents – (normal saline).

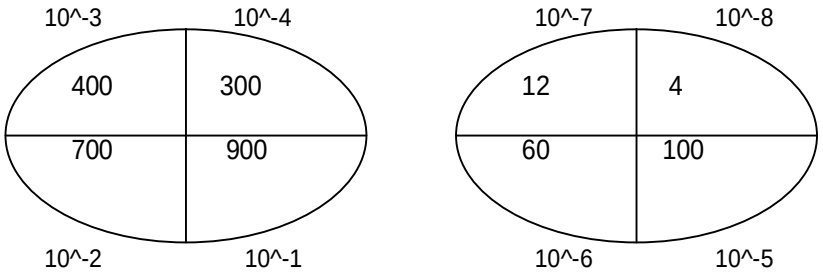
Remove 1ml of the culture and place in tube 1 and discard the pipette. Using another pipette take 1ml from tube 1 and place it in the second tube. Using another pipette take 1 ml from the second tubes and place it in the third one so on…



10^-1 10^-2 10^-3 10^-4

- You bring blood agar media, divide it into 4 quarters. Using 2 blood agar. Dry them thoroughly.
- Use 1\50ml dropper (Pasteur pipette) remove about 1 ml from the highest dilution (last dilution)

- Drop one drop in one quarter.
- Using the same pipette remove 1ml of the previous dilution and go on each time from the previous dilution.
- Using a bent glass rod, spread your drop starting by higher dilution.
- Leave to dry.
- Incubate over night, next day remove petri-dishes from incubator.



How we count the bacteria:

Take the last number of colonies which is 4 we have to multiply by 50 because we use 1\50ml dropper.

4 x 50 x 10^8 = 200 x 10^8 = 2 x 10^10 C.F.U/ml

1ml of original culture containing 2 x 10^10 C.F.U/ml

To be more accurate we can use 2 methods of calculation:-

1. Average method:-

- Here we use duplicates of blood agar bearing the same dilutions (do the same procedure in blood agar plates)
- Take the average of the last dilution.
  4+6/2=5
  1ml of original culture containing 5x50x10^8=2.5x10^10 C.F.U./ml.

2. Farmioloae method:-

In this method we count the last 2 dilution in the duplicates i.e.
4+6+12+18=40 colonies
40x2.2x10^8=10^9 C.F.U/ml

2.2 is a factor which nilify the dilution

Farmioloae is more accurate than the average method

If there is a confluent growth we have to do more dilutions.

ii. Total count:-

1) Glass slide method:
   1. Remove specific measured volume from a liquid culture (0.01ml) after shaking.
   2. Place it on a slide spread it gently.
   3. leave to dry, fix it by heat.
   4. stain with methylene blue for 30 seconds wash with water and dry.
   Start counting bacteria using the microscope. It is not accurate method because during fixation and staining we loose some bacteria.
2) Slide chamber : haemocytometer
   Add a drop of dye in the culture to stain it(methylene blue). Fill the chamber and then cover with a cover slip.
   Count bacterium in four squares and multiply by the multiplying factor 40.000

Chapter four

The Results:

The results of this study will be presented in this chapter in tables (1 – 5):

Table (1): show the average chemical composition of shoulder meat and bone meal:

Element	moisture	Protein	Fat	Ash	Calcium	Phosphorus
Mean ± std. deviation	8.8067 ± .16258	48 ± 1.73494	10.77 ± .69764	29.133 ± 1.76684	12.3700 ± .20421	6.0200 ± .92016

As shown in Table (1) the average chemical composition of shoulder meat and bone meal for mean and std. deviation was 8.8067 ± 0.16258 moisture, 48 ±1.73494 protein, 10.77 ± 0.69764 crude fat, 29.133 ± 1.76684 ash, 12.3700 ± 0.20421 calcium and 6.0200 ± 0.92016 phosphorus respectively.

Table (2) Show the average chemical composition of leg meat and bone meal:

Element	moisture	Protein	Fat	Ash	Calcium	Phosphorus
Mean ± std. deviation	9.3567± .44377	47.1000 ± .20000	9.2533 ± 1.00301	25.5750 ± .77587	12.8367 ± .77268	6.0033 ± .92116

As shown in Table (2) the average chemical composition of leg meat and bone meal for mean and std. deviation was 9.3567 ± 0.44377 moisture, 47.1000 ±0.20000 protein, 9.2533 ± 1.00301 crude fat, 25.5750 ± 0.77587 ash, 12.8367 ± 0.77268 calcium and 6.0033 ± 0.92116 phosphorus respectively.

Table(3) show the average chemical composition of lumber meat and bone meal:

Element	moisture	Protein	fat	Ash	Calcium	Phosphorus
Mean ± std. deviation	8.9000 ± .13077	45.8000 ± 1.81934	10.3667 ± .49329	25.3200 ± 1.03015	12.6567 ± .91511	6.2833 ± .41016

As shown in Table (3) the average chemical composition of lumber meat and bone meal for mean and std. deviation was 8.9000 ± 0.13077 moisture, 45.8000 ± 1.81934 protein, 10.3667 ± 0.49329 crude fat, 25.3200 ± 1.03015 ash, 12.6567 ± 0.91511 calcium and 6.2833 ± 0.41016 phosphorus respectively

Table (4): show comparison of chemical composition of meat and bone meal (MBM) from different carcass region:

Element / Region	moisture	protein	fat	ash	calcium	Phosphorus
Shoulder	8.8067	48	10.77	29.133	12.3700	6.0200
Leg	9.3567	47.1000	9.2533	25.5750	12.8367	6.0033
Lumber	8.9000	45.8000	10.3667	25.3200	12.6567	6.2833
Sig	NS	NS	NS	NS	NS	NS

Table (4) shown the comparison of chemical composition of meat and bone meal (MBM) from shoulder, leg and lumber, and there no significant was

found. The average of them as 9 % moisture, 46.9% protein, 10.13% fat, 26.6% ash, 12.6% calcium and 6% phosphorus.

Table (5): The level contamination and the contaminant of meat and bone meal:

Sample	Total count	E. coli	Salmonella
A	11X10^-6	+	–
B	22X10^-6	+	–
C	28X10^-6	+	–

Table (5) show the level of contamination of sample A was 11x10^-6, and contaminated by E .coli and free of salmonella. Sample B contamination level was 22x10^-6. The contaminant was E. coli and free of salmonella. The contamination level of sample C was 28x10^-6. The contaminant was E .coli and free of salmonella. Sample C is more contaminated with E. coli followed by sample B and A respectively.

Chapter five

Discussion

The results of chemical composition and contamination level of meat and bone meal will discussed in this chapter:

5.1- chemical composition:

5.1.1-moisture content:

The average moisture % of this study was 9%, the moisture content in this result was similar to that reported by Gogesh and shihde (2011) as ranging between 6-10%.Nagy and Rivis Adrian (2014) reported moisture content in meat and bone meal as 1.15 – 3.45 % and A. S. A. B. E (2006) as 1.9 – 5.7 % which was lower that the moisture was (8.96%) in this study. Backa topola (2010) found the moisture % in MBM as 9 % which was similar to present study. Dick Ziggers (2010) reported the moisture % of wide range of moisture in MBM as ranged from 3 – 11.2 % which was in average similar to the presentage.

5.1.2- protein content:

The average protein % of this was 46.9 %. The protein content in this result was similar to that reported by Gogesh and Shihde (2011) as ranging between 45 – 50 %. A. S. A. B. E (2006) and John H. Goihle (2013) reported protein %

of wide range of protein in MBM as ranged from 44.6 62.8 % and 42.7 – 57.2 % respectively which was in average similar to the percentage. Backa Topola (2010) study reported the protein content in MBM as 45 % which was lower than protein % of this study. Nagy & Rivis Adrian (2014) and Dick Ziggers (2010) and David L. Meeker (2006) and International feed (2018) as ranging between 50 – 59 %, 46 – 52.8 %, 50.4 %, 50 % respectively.

5.1.3- fat content:

The average fat % of this study was 10.13 %. The fat content of this study was similar to that reported by Dick Ziggers study (2010) and David L. Meeker (2006) and Backa Topola (2010) as ranging 8.5 – 14.8 %, 10% and 10% respectively. A. S. A. B. E. (2006) reported fat % of wide range of fat in MBM as ranged from 8.9 – 16 % which was in average similar to the study. Nagy & Rivis Adrian (2014) and John H. Goihle (2013) reported fat content in MBM as 13.1 – 16.7 %, 11.6 – 15.2 % respectively which was higher than fat % in this study. Gogesh and Shihde (2011) and international feed (2018) reported fat content in MBM as 5 -8 % and 6 % in order which was lower that the fat % in this study.

5.1.4- ash content:

The average ash % of this study was 26.6 %. The ash content in this study were similar to that reported by Nagy & Rivis Adrian (2014) and John H. Goihl (2013) as ranging between 23 – 30 %, 20.6 – 33 % respectively. A. S. A. B. E. (2006) reported ash % of wide range of ash in MBM as ranged from 20.7 – 39.9 % which was similar to the present. Gogesh and Shihde (2011) and international feed (2018) reported ash content in MBM as 35 – 40 %, 35 %respectively which was higher that the ash % in this study.

5.1.5-Calcium content:

The average calcium % of this study was 12.6 %. The calcium content in this study were similar to that reported by Gogesh and Shihde (2011) and Backa Topola study (2010) and Dick Ziggers (2010) as ranging between 8 – 12 %, 12 %, 6 – 12 % respectively. John H. Goihl (2013) and International feed (2018) and David L. Meeker (2006) reported calcium content in MBM as 5.09 – 11.03 %, 7 – 10% and 10.3% in order, which was lower that the calcium% in this study.

5.1.6-Phosphorus content:

The average phosphorus % of this study was 6 %. The phosphorus content in this study were similar to that reported by Gogesh and Shihde (2011) and International feed (2018) as ranging between 4 – 6 %, 4.5 – 6 % respectively. Backa Topola (2010) and John H. Goihle (2013) and Dick Ziggers (2010) and David L. Meeker (2006) reported phosphorus content in MBM as 5.90 %, 2.59 – 5.26 %, 3.5 – 5 % and 5.1 % respectively which was lower that the phosphorus % of this study.

5.2- contamination of MBM:

The contamination level of different MBM samples of this study were 11 x10 ^6 , 22 x 10^6 and 28 x 10^6 for sample A. B. and C respectively. The contaminant bacteria of samples of this study was E. coli, while no salmonella contamination was found.

CONCLUSION AND RECOMMENDATION

CONCLUSION:

The study was concluded that meat and bone meal can be produced from rendering carcass, after drying and grinding the percentage of calcium and phosphorus were 2:1.

RECOMMENDATION:

- We recommend for the continuation of studies for meat and bone meal production using different animal species.
- Use hot air oven for drying MBM to keep the product as safety as possible.

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