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Design and Fabrication of Horizontal Screw Type Mixer for Livestock Feed Meal

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ABSTRACT

Small-scale livestock raisers are in dire need of a highly nutritious poultry feed to increase production output. And efficient mixing is the next key to good feed production. The mixing time for a batch of ingredients varies according to the design of the mixer, thus designing a fabricated horizontal screw type mixer was necessitate. The horizontal screw type mixer for livestock feed meal was fabricated using metal working concepts. The main components are the housing, bucket, rotor assembly and gear box. Experimental design was made to obtain the machine performance like pulley ratio, number of paddles/ blades, and the driving gear ratio. The machine used four (4) inches diameter pulley at the gear box and seven (7) inches diameter pulley at the gear box and seven (inches) diameter pulley at the motor connecting with a V-belt, eight paddles were installed at the rotor shafting for good mixing capability. The driving gear used 18 teeth at the upper sprocket and 36 teeth at the lower sprocket to obtain past and efficient mixing of raw materials in the production of feeds. It is powered by one half horse power electric motor. The machine could produce in an average of 15 kilograms in two (3.66) minutes.

Keywords – Technology, fabricated horizontal screw mixer, livestock feeds, experimental design, Philippines

INTRODUCTION

Backyard hog raiser is one of the added sources of income of small holder farmers in Ilocos Sur and in the region. Farmers usually raise 5- 20 heads of swine for ready source of cash for the family; and some had already ventured in a medium-scale production to cope up the demand of pork and other value adding productions such as " longanisa", pork "chicharon" and the like.

Food is one of the most important basic needs of animals like the hogs in order to survive. That is why food and machinery are related in terms of food production, preparation and other processes. Traditionally, small scale hog, cattle and poultry raiser like the researcher, used manual or hand to mix the crushed feed. Venturing into medium scale production, machineries is needed for the purposed of mixing an ingredients to turn into feeding of the animals. Machine is a well-known structure consisting of frame works with various moving parts for doing the job easier, faster and more quality output. In addition, machine is a device which requires a certain amount of electrical energy to operate its moving part.

Zhang, Finger, and Behrens (2003) describe the functions of link mechanism is to produce rotating, oscillating or reciprocating motion from the rotation of the crank or vice versa.

Applying oscillating or reciprocating motion in designing and fabrication of horizontal screw type mixer will produce less torque resulting to low efficiency because it defends only to the force needed in mixing livestock feed ingredients.

In fabrication of the machine it is composed of rotating and oscillating parts which produce to operate effectively, but cause accidents if it is not properly installed and mounted. Hence, The Philippine Mechanical Code, section 3.10.A 3.10.B and section will be followed as stated " Hazardous revolving or reciprocating parts shall be guarded, and Guards may be provided with hinge or removable mechanism whenever it may be necessary to change belts, to make adjustments, or to apply lubrication to the guarded parts."

In the fabrication of the Horizontal Screw type Mixer all safety precautions will be followed. Raisers like the researcher are in dire need of a highly nutritious food to increase production output. Machineries sold in the market are very expensive in the part of raisers. Hence, this study is conceptualized to Design and fabrication of Horizontal Screw Type Mixer.

The result of this study could lead several experimentation, more efficient operation of the horizontal screw type mixer. The new fabricated design machine will improved the production of mixing the ingredients of livestock feed mill without large capital expenditure. Additionally, the existing labor on a small farm may be able to absorb the extra load of making feeds, keeping operational costs low. Farm-made compound feeds provide a potentially cheaper alternative to the purchase of commercially manufactured product. Further, the farmer have the opportunity to increase productivity.

FRAMEWORK

The design of the horizontal feed mixer proceeded through following paradigm. It is operated by a ½ horsepower motor in order to rotate the rotor by means of a pulley and the V-belt. The rotor consists of horizontal screws, paddles or metal ribbon blades mounted on a horizontal rotor with in a semi-circular trough. The move of the material from one end of the mixer to the other, tumbling as it goes. This mixer will discharge the mixed product from the bottom, using the mixer blade action.

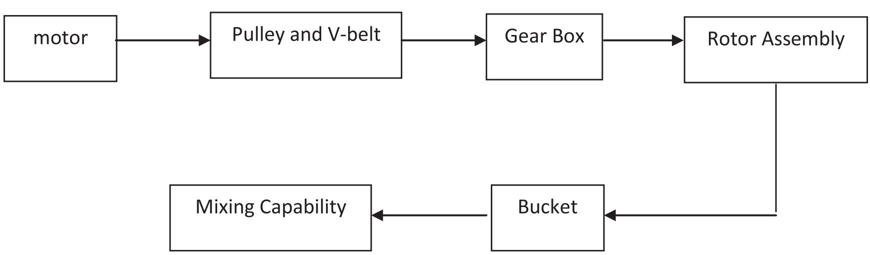

Figure 1. Process flow of the study

This study is founded on the theory that design and development of horizontal ribbon type feeds mixer provides savings on unit feed costs achieved by small-scale on-farm feed production. In addition, the study is fundamentally focused on determining possible effect of feed mixers because there is always an optimum level needed by farmers specifically small scale farm owners to attain maximum net income.

Some farm owners in the province failed to achieve high net income due to high cost of commercial feeds. One contributory factor to their failure is the lack of information that would eventually reduce their input on feeds commercially manufactured by feed millers, and sold in the market.

To provide reliable data and information to farm owners and backyard raisers, the researcher in this experiment developed the design of horizontal ribbon type feeds mixer as alternative to highly costs feed mills to obtain maximum return. Hence, some studies and related literature are hereunder cited which served as bases and guidance of the researcher in conducting the experiment.

According to Orriss(1997) ribbon mixer is one used in manufacturing and industrial applications. Ribbon mixers are also occasionally called ribbon blenders. They are usually used when one of the items being mixed has a lot of particles, and it's important that all ingredients are mixed evenly. The mixer has a central shaft with mixing blades angled in different ways that look like ribbons of metal wrapped around the shaft, and is able to move parts of the mixture in different directions at the same time, ensuring that all ingredients are blended in. It can be used for food or medicine manufacturing as well as for heavier industry.

The ribbon mixer consists of some type of closed container, usually with a shape similar to a feed through. The shaft with attached blades is located inside the container. Blades of the ribbon mixer are look like two metal ribbons winding around the shaft, in a double helix design. The ribbon mixer can have a horizontal construction, where the shaft and blade are sideways in container, or the shaft and blade can be in a vertical position.

A ribbon mixer usually operates very slowly, and requires a lot of power to work. The blade is formed and angled in a way that allows the mixture to move in two directions at once. The mixture in the outer part of the container typically moves in one direction, while the mixture near the center of the container moves in the opposite direction. The shape of the ribbon mixer also ensures that no ingredients are left undisturbed on the bottom of the container, and that all portions of the mixture are blended evenly with the same ratio of ingredients.

Orriss (1997) added the use of a ribbon mixer is not recommended for mixtures that have sticky final product as the unique design of the blade makes it difficult to clean sticky substances off to it. However, ribbon mixers are an ideal choice for many other applications. They can be used for wet or dry mixtures, and they mix ingredients evenly, yet gently. A few examples of dry mixtures are fine gravels, powders, pets or farm animal foods, cereals. Snack mixes, and certain medications. Examples of wet or moist mixtures include the many types of dough used in commercial bakeries, as well as resins and plaster used for manufacturing building materials.

Vertical mixers are unsuitable for mixing wet ingredients. Horizontal mixers are more suitable but, because of their complex construction, are often difficult to clean properly. There is also a tendency for sticky materials to adhere to the blades and to accumulate at one end of the mixer. Simple bowl or circular mixers are the most suitable types for mixing wet ingredients or mixtures of wet or dry materials. They can also be used for mixing dry ingredients. This type of mixer is available in sizes suitable for mixing a few kilograms or of dealing with several tons of ingredients. The larger types discharge the mixed product from the bottom.

Chicken horizontal feed mixer consists of a series of paddles or metal ribbon blades mounted on a horizontal rotor within a semi-circular trough. The blades move the material from one end of the mixer to the other, tumbling it as it goes.

Vertical mixers are the most common type found in small livestock feed mills. However, the vertical type is well suited to aquaculture, poultry and fish feeds than the horizontal type, which are much more efficient in blending in small quantities if liquids (such as added lipids) or in mixing ingredients with different particle sizes.

Ribbon mixer paddle mixer had consisted of a series of paddle or metal ribbon blades mounted on a horizontal rotor within a semi-circular trough. The blades move the material from one end of the mixer to the other, tumbling it as it goes. These mixers usually discharge the mixed product from the bottom, using the same mixer blade action. See above the inside views of both a paddle mixer and a ribbon mixer.

Simple Mixtures as the title implies, this is simply the act of mixing two or more ingredients together. The raw materials used may be all dry, all moist, or a mixture of both. The purpose of mixing them, rather than feeding them to the animals separately, is to provide a more balance feed (i.e., not all high protein ingredients or all high carbohydrates etc,).

A simple mixture like this, particularly one consisting of dry materials only, does not remain a single feed once it is put into water in which the animals live. It will tend to break down very quickly into its components parts. However, it is a simple way of providing a better feed than a single ingredient. Simple mixtures, such as groundnut cake and rice ban, are often made for this purpose where no feed making equipment is available on the farm at all.

The ingredients should be as finely ground when purchased as possible, to ensure that the stock can ingest them. The mixing process can be done by hand, by shovel on the floor, by pounding in a bowl, or by simple mechanical mixer. A concrete mixer will do.

The main thing to be careful about in this type of simple mixing is that the proportions of the ingredients are correct and that no contamination occurs. The ingredients should be weighed out, not measured by volume, because the bulk densities of different ingredients vary widely. An alternative method is to weigh one batch of each ingredient and then to mark its volume container specifically reserved for that ingredient, using volume measurement in each successive batch. Even this is a little inaccurate however, because the bulk density of the same ingredient can vary, especially according to its particle size. Care must be taken to see chat only the intended ingredients are included in the mixture. Make sure that the ingredients are well identified and that chemicals which may be stored nearby are not included by mistake. Do not mix feed on a floor area which is contaminated with herbicides or pesticides (Orriss 1997).

Feed grains are the most important source of animal feed globally. The amount to grain used to produce the same unit of meat varies substantially. According to an estimate reported by the BBC in 2008, «Cows and sheep need 8kg of grain for every 1kg of meat they produce, pigs about 4kg. The most efficient poultry units need a mere 1.6kg of feed to produce 1kg of chicken. Farmed fish can also be fed on grain, and use even less then poultry. The two most important feed grains are maize and soybean, and the United States is by far the largest exporter of both, averaging about half of the global maize trade and 40% of the global soya trade in the years leading up the 2012 drought. Other feed grains include wheat, oats, barley, and rice, among many others. Traditional sources of animal feed include household food scrap and the by-products of food processing industries such as milling and brewing. Scraps fed to pigs are called slop, and those fed to chicken are called chicken scratch. Brewer's spent grain is a by-product of beer making that is widely used as animal feed (Orriss 1997).

Animal feeding practices have changed considerably over the past century. As large-scale, concentrated production methods have become the predominant model for animal husbandry, animal feeds have been modified to include ingredients ranging from rendered animals and animal waste to antibiotics and organoarsenicals. Evidences, that current feeding practice lead to adverse human health impacts.

The U.S. animal feed industry is the largest producer of animal feed in the world (Gill 2004). In 2004, over 120 million tons of primary animal feed, including mixes of feed grains, mill by-products, animal proteins, and micro ingredient formulations (i.e., vitamins, minerals, and antibiotics) were produced in the United States (Gill 2004). In the same year, the United States exported nearly $4 billion worth of animal feed ingredients. The structure of the U.S. animal feed industry is complex, with a multitude of industries and individual producers contributing to the production, mixing, and distribution of feed ingredients and complete feed products. However, there are a few firms that play principal roles in the manufacture of U.S. feeds, including feed mills, rendering plants, and protein blenders. Feed mills combine plant- and animal-based feed ingredients to produce mixes designed for specific animal species. Rendering plants transform slaughter by-products and animals that are unsuitable for human consumption into animal feed products using grinding, cooking, and pressing processes (GAO 2000; National Renderers Association Inc. 2005a). Protein blenders mix processed plant- and animal-based protein ingredients from many sources into animal feeds (GAO 2000). Once animal feed ingredients are mixed, an estimated 17,500 U.S. animal feed dealers distribute the final feed products to individual feeding operations (Feedstuffs 2005).

Another major animal protein–based feed ingredient is animal waste, including dried ruminant waste, dried poultry litter, and dried swine waste (AAFCO 2004). As with rendered animal products, there are no national data on the total amounts of animal waste included in animal feeds, although some states have collected limited data concerning this practice. In 2003, it was estimated that approximately 1 million tons of poultry litter were produced annually in Florida, and an estimated 350,000 tons of this litter were available for use in feed (Dubberly 2003). Yet, information concerning the precise amount of this "available" poultry litter that was actually incorporated into Florida animal feed was unavailable.

Recycling animal waste into animal feed has been practiced for > 40 years as a means of cutting feed costs. However, the U.S. Food and Drug Administration (FDA) does not officially endorse the use of animal waste in feed and has issued statements voicing the agency's concern about the presence of pathogens and drug residues in animal waste, particularly poultry litter (FDA 1998). In line with these concerns, the AAFCO, an organization that develops guidelines for the safe use of animal feeds, advises that processed animal waste should not contain pathogenic microorganisms, pesticide residues, or drug residues that could harm animals or eventually be detected in animal-based food products intended for human consumption (AAFCO 2004).

In addition to animal protein–based ingredients, fats originating from both plant and animal sources are included in animal feed and may contain contaminants such as dioxins and polychlorinated biphenyls (PCBs), which are harmful to human health. In 1988, the USDA (1988) reported that approximately 1.3 million metric tons of fats were used in the production of U.S. primary animal feed. Unfortunately, as with many other animal feed ingredients, we were not able to obtain recent data. Yet, because as much as 8% of feed could be composed of fats alone (Schmidt 2004), the quality (i.e., contaminant levels) of both plant and animal fats used in animal feed could be important factors in the ultimate safety of animal-based food products.

Metal compounds are also administered in animal feeds, and the compounds currently added to both swine and poultry feeds that are particularly concerning from a public health perspective are organoarsenicals. The most commonly used organoarsenical, roxarsone (4-hydroxy-3-nitrobenzenearsenic-acid), is administered to feeds at concentrations ranging from 22.7 g/ton to 45.4 g/ton to promote growth and improve feed efficiency (Chapman and Johnson 2002). When used in combination with ionophores, roxarsone also act as a co-coccidiostat to control intestinal parasites (Chapman and Johnson 2002). Once roxarsone is ingested by animals, the parent compound can be degraded into inorganic arsenite (AsIII) and inorganic arsenate (AsV) in animal digestive tracts and animal waste (Arai et al. 2003; Stolz et al. 2007). Both AsIII and AsV are classified by the U.S. Environmental Protection Agency (U.S. EPA) as group A human carcinogens (U.S. EPA 1998). Many other metallic compounds are also mixed into feeds, including copper, manganese, magnesium, and zinc compounds, as well as metal amino acid complexes (AAFCO 2004).

OBJECTIVES OF THE STUDY

The overall objective of this research is to design and develop horizontal ribbon type feed mixer so that some of the hog and cattle raiser developments shall be realized; to wit: Assemble the component of the horizontal screw type feed mixer for livestock feed mills, Dry-run and test the performance in the different parameters to obtain the productive performance of the machine in the following main component; Pulley ratio between the gear box and the motor; Number of paddles or blades, a)Driving gear ratio of sprocket, and b) Using the motor size. Further, the significant difference between and among the different combination parts will be measured.

MATERIALS AND METHODS

This study used the experimental type of research conducted in two phases namely, Phase 1: The design and fabrication of the machine; and Phase 2: Qualitative testing to identify the mixing capacity.

The designed machine computation of the horizontal feed mixer to handle a 15 Kg. mass of feed was done, for proper machine design approach. The machine was designed using AUTOCAD 2D design software and proper material selection was done before the assembling and fabrication of parts. The efficiency of the machine, its associated cost of production and the product obtained after few minutes of mixing were outstanding, thereby, making the design acceptable and cost effective.

The horizontal feed mixer was constructed by the following major parts; Electric Motor, the mixing trough, metal bucket, Shaft Pulley, Motor Pulley, Set of blades mounted on the shaft, Bearings, speed reducer (gear box), Shaft, Supporting Structures, and V-Belt. The machine can achieve the desired poultry feed mixing based on the proper design specification of the various components of the machine and it will be tested in different trials to obtain efficient operation.

Frequency and percentage were utilized to determine the mixing procedures. Mean were used to give summary statistics and information on the level of the mixing procedure. The ANOVA were used to find out whether there is a significant difference of the assembled machine over the commercial one found in the market.

Procedure in fabricating the machine

1. Cut the 1"x1"x20" angle bar into different sizes required in making the frame of the mixer bucket: a) cut four pieces eleven inches long, use as a brace of mixer b) cut two pieces 20 inches long, use as bucket frame.
2. Divide the stainless plain sheet into three: 1 piece 20 inches by 52 inches, use as bucket; 2 pieces 12 by 20 for the left and right siding.
3. Cut into eight the 24 inches by .25mm stainless steel, use as paddle bucket.
4. Weld the parts being used for the mixer's frame.
5. Put inside the frame the 20 by 52 inches stainless steel to form bucket.
6. Attached the right side siding to connect the right pillow block bearing with 8 inches upper part centered to the bucket.
7. Assemble the 4 paddles connected to the 24" main shaft.
8. Put the 22 pieces 3/16 machine bolt and knot to lock the right side siding.
9. Lock the pillow block on the right, Lock the pillow block on the left side.
10. Attached the 36 teeth sprocket to the main driving shaft and lock.
11. Attached the chain for transmission to the gearbox.
12. Weld the basement of the gearbox.
13. Weld the basement of the driving electric motor.
14. Lock the gearbox on its basement.

15. Lock the electric motor to its basement.
16. Put the v-belt to the gearbox pulley connected to the electric motor 4 inches diameter pulley.

Assembly of the component of the Horizontal Feed Mixer for Livestock Feed Mills

a. Housing Structure
b. Motor, Pulley, V-belt and the speed reducer relationship. The electric motor has 1750 rpm speed. In order to attain the speed reduction, a 3 inches diameter of motor pulley was used. A 6 inches pulley was also used at the speed reducer (the gearbox to drive from the motor to the gearbox using V-belt.
c. Speed Reducer (Gearbox) and the Rotor/Shafting Assembly

Figure 1

Figure 2

Figure 1 and 2 during the fabrication process of housing

Dry run and tested performance in the different parameters to obtained the productive performance of the machine

A series of experimental design were made to obtain the machine performance like performance of the machine thru pulley ratio, the different number of paddles or blades, driving gear ratio. Series of trials were made to obtain the productivity of the machine.

Figure 3. Installation of gear box and motor

Figure 4. The paddle design

RESULTS AND DISCUSSION

On Performance of the machine thru Pulley Ratio between Gearbox and Motor

There were three trials conducted to obtain the performance of the machine through pulley ratio at the gearbox and the motor.

Table 1. Performance of the machine thru pulley ratio between gearbox and motor

Variables		Output			
Gearbox	Motor	T1	T2	T3	Average
a. 4 inches diameter	3 inches diameter	6 min	5 min	4 min	5 min
b. 4 inches diameter	5 inches diameter	6 min	4 min	3 min	4.33 min
c. 4 inches diameter	7 inches diameter	5 min	4 min	2 min	3.66 min

Table 1 presents the three variable combinations of gearbox and motor ratio pulley. And it was made three trials for each combination of gearbox and motor to obtain the average time in mixing a raw material of feeds.

Combination of gear ratio are: First, 4 inches diameter at gearbox and 3 inches diameter at the motor pulley; Second, 4 inches diameter at gearbox and 5 inches diameter at the motor pulley; and the Third combination, 4 inches diameter at gearbox and 7 inches diameter at the motor pulley. In every combination and three trials were to obtain the best combination of pulley, to look into the normal operation of the motor in consideration the capacity rating not to be overheated and overloaded the motor.

As gleaned at the table, it is evidently seen that variable letter a, gave an average of 5 minutes, variable letter b is 4.33 minutes, and variable letter c, gave 3.66 minutes in mixing raw material of feeds in equivalent of 15 kilograms.

Of the three variables of combination, using a 4 inches diameter of pulley at gearbox and 7 inches diameter of the pulley of the motor gave the best mixing time with an average of 3.66 minutes in mixing an ingredient of 15 kilograms livestock feeds. This implies that the larger the pulley of the motor than the gearbox shown a faster performance of the horizontal screw type feed mixer machine to mix a raw material in the production of livestock feeds without abnormality in operation of the electric motor.

This is in consonance to the statements of Orriss (1997) , ribbon mixer usually operates very slowly, and requires a lot of power to work. The blade is formed and angled in a way that allows the mixture to move in two directions at once. The mixture in the outer part of the container typically moves in one direction, while the mixture near the center of the container moves in the opposite direction. The shape of the ribbon mixer also ensures that no ingredients are left undisturbed on the bottom of the container, and that all portions of the mixture are blended evenly with the same ratio of ingredients.

On Performance of the Machine on the Different Number of Paddles or Blades

In assembling the rotor to drive the raw material while mixing feeds are important to consider. The number of paddles or blades should be properly selected. Paddles or a blade gives the perfect mixing capability of the machine. There were three sets of variables in identifying a good mixing performance in consideration of the positions of the paddles or blades.

Table 2 presents the different design of the paddle or the blades. Variable number 1 having 2 paddles with ribbon, variable number 2 having 4 paddles with ribbon, and the variable number 3 having 8 paddles with ribbon.

Table 2. Performance of the machine thru the different number of paddles or blades

Variable	Output			
Number of Paddles	T1	T2	T3	Average
2 Paddles	10 min	10 min	10 min	10 min
4 paddles	8 min	8 min	8 min	8 min
8 paddles	3.66 min	3.66 min	3.66 min	3.66 min

In every variables, the machine was observed to obtain the average time in mixing and how it work in normal operation of the paddle and the way it mixed the raw materials in the production of livestock feeds.

It can be seen that using 2 paddles on the rotor driver, it gave an average of 10 minutes to mix raw material of livestock feed with a volume of 16 kilograms. And the second variable gave an average of 8 minutes using 4 paddles; while the third variable gave an average of 3.66 minutes having to use 8 paddles or blades.

The result implies that the third variable having the greatest number of paddles gave the best performance, that take only a 3.66 minutes in a good standard procedure of mixing the ingredients. It was further observed that no abnormalities observed from the motor, like raising of the ampere rating.

The machine was also tested using the 4 paddles or blades removing the ribbon. It was observed that a slower time in mixing the ingredient, and a poor quality of feeds output. The researcher decided that the ribbon of the paddle will be re-installed.

This related to the statement of Orriss (1997) that Ribbon mixer paddle had consisted of a series of paddle or metal ribbon blades mounted on a horizontal rotor within a semi-circular trough. The blades move the material from one end of the mixer to the other, tumbling it as it goes. These mixers usually discharge the mixed product from the bottom, using the same mixer blade action.

On the Performance of the Machine on the Driving Gear Ratio and Sprocket

To give more efficiency on the operation of the machine, a combination of upper and lower sprocket of the motor and the driving gear box were identified. It was carefully observed for a good quality as mixing the ingredients of the livestock feed.

Table 3 presents the result of performance of the horizontal screw type feed mixer machine in the two sets of driving gear ratio.

Horizontal ribbon mixer is a new type of mixing equipment with high efficiency, high uniformity, high load factor, low energy consumption, low pollution and little destruction to frangible material. It is widely used to mix powder-powder and powder-liquid, especially materials that are paste, viscous or with big specific gravity such as putty, stone coatings, metal powders, etc. Horizontal ribbon mixer consists of transmission parts, double ribbon agitators and U-shape cylinder. In the direction of rotation, the outer ribbon pushes materials from both ends to the middle to both ends. Ribbon wind with different angle direction carries the materials flowing in different directions. Through continuous convective circulation, the materials are sheared and mixed thoroughly and quickly. In addition, it is cheap and is therefore frequently used in farms, particularly in South East and South Asia (Orriss 1997).

Table 3. Performance of the machine thru the driving gear ratio

Variable	Output			
	T1	T2	T3	Average
18 teeth lower sprocket 36 teeth upper sprocket	3.66 min	3.66 min	3.66 min	3.66 min
36 teeth lower sprocket 18 teeth upper sprocket	2 min	2 min	2 min	2 min

The data from the table reveals that the performance of the horizontal screw type feed mixer machine through driving gear ratio of 18 teeth lower sprocket and 36 teeth upper sprocket had an average of 3.66 minutes to mix a raw materials. While using a 36 teeth upper sprocket and 18 teeth upper sprocket it takes only two minutes to mix raw materials to feeds. This result implies that if the lower sprockets have a greater number of sprockets the faster to mix raw materials in the production of feeds. On the contrary if the upper sprocket contains a greater number of sprockets the performance of the machine to mix a raw material to becomes slower. Of all the trials done like selecting the pulley ratio between the gearbox and the motor, number of paddles or blades and the proper selection of the driving gear ratio and the sprocket was obtained more faster and efficient mixing 16 kilos of ingredients from 3.66 minutes to two (2) minutes.

On the Performance of the Machine on choosing the motor size

For an efficient and economical way of electric energy consumption, the machine was also carefully chosen. There were three sets of motor being used to assess the capability in mixing ingredients of the machine.

The first trial is by using 1 horsepower rating of the motor at 1750 revolution per minute. And the second trial is by 1 ½ horsepower rating, and the third trial is by using a ½ horsepower motor.

Using the first trial and the second trial using 1 horsepower and 1 ½ horsepower motor, gave a good mixing of ingredient capability of the machine respectively. There were no abnormalities being observed while in operation and mixing of 16 kilos in just 2 minutes. Using these two trials, it was observed that the motor operates free-load. The ampere rating did not increased, which means that the motor is so big enough to drive the machine.

The researcher tried to use a one half horsepower rating. The idea of reducing the size of motor was based on the observation on the ampere ratings of the two first trials.

It is observed that the performance of the horizontal ribbon type feed mixer machine using ½ horsepower electric motor can drive the machine ideally. The same average time of 2 minutes to mix raw materials of feeds with an ideal operation. This is a manifestation that using ½ horsepower electric motor had an ideal and efficient operation without affecting any sensitive part of the machine. This implies that using lower size of electric motor has lesser current drawn. This implies further an economical current consumption of the machine.

On the level of the performance of the machine between and among the different combination variables

The level of performance was compared with the different components to determine whether the component differs significantly in the production of mixing ingredient. The mean score in the level of the different variables were there subjected to test of differences.

Table 4. Result of ANOVA testing for significant difference in the level of performance and among the different trials of component

Components	F-ratio	F-Sig	Decision
Pulley	9.60	p<0.05	Reject Ho
Paddles	0.00	p>0.05	Do not reject Ho
Gear	0.00	P>0.05	Do not reject Ho

The result of the One-way Analysis of Variance (ANOVA) shows that there is no significant difference in the level of performance among the different variable groups of components. This implies that the groups of variables are not significantly different or are not affected by the normal operation of the machine.

To find out which groups are significantly different in their level of operation, the means of component were further subjected to multiple range test through the Post Hoc Tests Method.

Table 5. Scheffe test in the level of operation of the different components

Multiple Comparisons
Scheffe

	(I) output	(J) output	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Dependent Variable		3.00	2.66667*	.60858	.013	.7148	4.6185
	2.00	1.00	-1.33333	.60858	.171	-3.2852	.6185
		3.00	1.33333	.60858	.171	-.6185	3.2852
	3.00	1.00	-2.66667*	.60858	.013	-4.6185	-.7148
		2.00	-1.33333	.60858	.171	-3.2852	.6185
Paddles	1.00	2.00	.00000	2.64641	1.000	-8.4877	8.4877
		3.00	.00000	2.64641	1.000	-8.4877	8.4877
	2.00	1.00	.00000	2.64641	1.000	-8.4877	8.4877
		3.00	.00000	2.64641	1.000	-8.4877	8.4877
	3.00	1.00	.00000	2.64641	1.000	-8.4877	8.4877
		2.00	.00000	2.64641	1.000	-8.4877	8.4877
Gear	1.00	2.00	.00000	.78253	1.000	-2.5098	2.5098
		3.00	.00000	.78253	1.000	-2.5098	2.5098
	2.00	1.00	.00000	.78253	1.000	-2.5098	2.5098
		3.00	.00000	.78253	1.000	-2.5098	2.5098
	3.00	1.00	.00000	.78253	1.000	-2.5098	2.5098
		2.00	.00000	.78253	1.000	-2.5098	2.5098

*. The mean difference is significant at the 0.05 level.

	Pulley	Paddles	Gear
Pulley	---		
Paddles	0.171	---	
Gear	0.013*	0.171	---

*Significant at 0.05 level

Table 5 presents the result of Scheffe test on the level of operations of the different components. The data reveal that there is no significant difference on the level of operation on the use of pulley and paddles.

However, there is a significant difference on the operations with respect to the use of pulley and gear. Pulley ratio should match the gear ratio to attain the desired speed operation of the paddles. Revolution of the paddles should have a desired speed operation based on the output of the driving gear. Moreover, on the use of paddles and gear, there is no significant difference.

CONCLUSIONS

On the basis of findings, the following conclusions are hereby deduced. Stainless plain sheet was used in the fabrication of bucket and paddle or blades and stainless rod was also used as the shafting of the rotor assembly. Gear box is used to reduce the speed ratio of the motor to the rotor assembly by means of using sprocket and chain.

Designing the Horizontal Screw Type Feed Mixer was fabricated on the desired specification as per in the working drawing. Combination of pulley ratio of the gearbox and the motor a four inches diameter pulley was used at the gear box while seven inches diameter pulley at motor. There were eight paddles or blades with ribbon that gave the best productive performance. The driving gear and the sprocket used 36 teeth upper side while 18 teeth sprocket lower side gave the right combination and resulted faster from 3.66 minutes to two minutes to produce 15 kilograms of feed. The machine was powered by ½ horsepower motor.

There is a significant difference on the operation with respect to the use of pulley and gear. Wet-milling, drying processes of raw materials ingredient were prepared. Performance of the machine gave the key to good feed production.

RECOMMENDATIONS

Based on the conclusions drawn from this study, the following recommendations are hereby suggested. Hog and Fowl raisers should adapt the use of feed mixer machine. The Department of Science and Technology should evaluate the ease of handling and safety features of the machine for patenting and commercialization. There should be an inspection to feed millers regarding proper measurement of the ingredients.

LITERATURE CITED

Arai, Y., Lanzirotti, A., Sutton, S., Davis, J.A., Sparks, D.L.
2003 Arsenic speciation and reactivity in poultry litter. Environ Sci Tech. 2003;15:4083–4090. Retrieved on July 7, 2014 from http://goo.gl/ZkDYxy

Chapman, H.D., Johnson, Z. B.
2002 Use of antibiotics and roxarsone in broiler chickens in the USA: analysis for the years 1995 to 2000. Poult Sci. 2002;81:356–364. Retrieved on July 7, 2014 from http://goo.gl/6SqVZ1

Dubberly, D.
2003 Substances Prohibited from Use in Animal Food or Feed; Animal Proteins Prohibited in Ruminant Feed. Docket: 02N-0273, Comment no.: EC -31. Washington, DC:U.S. Food and Drug Administration. Retrieved on July 7, 2014 from http://goo.gl/8dGEG1

Feedstuffs Feed marketing and distribution
2005 Feedstuffs. 77:4.

GAO
2000 Food Safety: Controls Can Be Strengthened to Reduce the Risk of Disease Linked to Unsafe Animal Feed. GAO/RCED-00-255. Washington, DC: General Accounting Office. Retrieved on January 3, 2006 from http://goo.gl/qtTUpJ

GAO
2002 Mad Cow Disease: Improvements in the Animal Feed Ban and Other Regulatory Areas Would Strengthen U.S. Prevention Efforts. GAO-02-183. Washington, DC:General Accounting Office. Retrieved on March 22, 2007 from http://goo.gl/FmgEWZ

Gill, C.
2004 Top ten feed makers worldwide. Feed Manag. 2004;55:38–40. Retrieved on July 7, 2014 from http://goo.gl/xrCdG9

Orriss
1997 FDA Requests that Ball Clay Not Be Used in Animal Feeds. Rockville, MD:U.S. FDA Center for Veterinary Medicine. Retrieved on January 23, 2006 from http://goo.gl/R7kBSH

Schmidt
2004 AAFCO Official Publication. Oxford, IN: Association of American Feed Control.

Stolz, J. F., Perera, E., Kilonzo, B., Kail, B., Crable, B., Fisher, E., ... & Basu, P.
2007 Biotransformation of 3-nitro-4-hydroxybenzene arsonic acid (roxarsone) and release of inorganic arsenic by Clostridium species.*Environmental science & technology*, *41*(3), 818-823.doi: 10.1021/es061802i. Retrieved on January 10, 2007 from http://goo.gl/kfO9Gn

U.S. DA
1998 Integrated Risk Information System.Arsenic, Inorganic (CASRN 7440-38-2)

Washington, DC:U.S. EPA Integrated Risk Information System. Retrieved on March 26, 2007 from http://goo.gl/o7JBCi

Zhang, Y., Finger, S., & Behrens, S.
2003 *Introduction to mechanisms*. Carnegie Mellon University. Retrieved on August 28,2013, from http://goo.gl/R5jG5N