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COMPARATIVE ANALYSIS OF A FABRICATED CALCIUM CARBIDE HOVER AND KEROSENE LAMP AS HEAT SOURCES FOR POULTRY BROODING

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Abstract: A fabricated Calcium Carbide Hover and Kerosene Lamp were used as sources of energy for brooding day old chicks. Six (6) brooding boxes were constructed and used for this experiment. One hundred and twenty (120) chicks were bought at day old with each box having twenty (20) chicks. Feed and water were supplied three times daily. Temperature was measured using wet and dry bulb thermometer four (4) times daily at six (6) hours interval. Feed supplied was measured on daily bases. Standard feed conversion ratio was used to determine feed intake and body weight gain of the chicks which were recorded on weekly bases using weighing balance. Mortality of chicks for both energy types of brooding was recorded. Results obtained showed that brooding hover had a mean temperature of 31.0^{0}C while kerosene lamp had 30.8^{0}C. Mortality for carbide hover was 5%, while kerosene lamp was 8.33%. The cost of brooding using carbide hover was ₦2,868.00 and kerosene lamp was ₦3,827.25. Brooding hover had a mean body weight gain of 0.424kg as against 0.414kg for kerosene lamp. Feed conversion ratio was 1.5 for carbide hover and 1.6 for kerosene lamp. ANOVA results showed that there was significant difference in cost of operation but no significant difference was observed between the temperatures, mortality rates, and feed conversion rates for the two energy types considered. This experiment showed that hover can be used as an energy source for small scale brooding in place of kerosene stove.

Keywords: Calcium Carbide Hover, Kerosene Lamp, Heat, Poultry and Brooding.

INTRODUCTION

Brooding is the way in which young chicks are supported with artificial heat to boast their body temperature. [1] and [2] Defined it as the behaviors by parent birds of "Setting on" their chicks in order to warm them, contend them or shade them until they are about two weeks old.

Heat is required from the time chicks are hatched until they are about six weeks old. Chicks may be brooded in many places in the farm. The main requirements are adequate space, reliable source of heat and proper ventilation [3]. This is difficult to achieve in village set up, but commercial system can do so in a number of ways, through whole house brooding, or partial house brooding to conserve heat and reduce energy cost [4]. Correct temperatures are more easily maintained in a small area. Ventilation also needs to be considered, as it distributes heat to the birds and helps maintain good air quality in the brooding area. The heat requirement for day old chicks is about 90-95^{0}F [5]. Furnaces and brooders are the two basic methods of providing heat for chicks in brooding house. [6] Mentioned three methods of warming chicks; (warm room brooding), hover (or pan lake) brooding and radiant brooding.

Poultry meat is a good source of quality proteins, minerals and vitamins for human diet and industrial uses. Poultry farming provides source of income and gainful employment to farmers. Poultry wastes are useful source of organic fertilizer for increasing crop yield [7].

Hover is a metal tray suspended from the roof on which electrical bulb is placed to provide heat for chicks in a brooding house. [8] Defined hover as any portable device or machine with a temperature regulator that provides heat and light for brooding of chicks in brooding house. Calcium carbide is made by heating line and coke in an electric furnace at temperature of about 2000^{0}C it is used largely in the preparation of butylenes by reacting with water which provides or supports burning flames for the heating and lighting purposes.

Calcium carbide is a chemical compound with the chemical formula of CaC_2 the pure material is colorless, but most samples have a color ranging from black to grayish-white, depending on the grade [9]. Its main use industrially is in the production of acetylene and calcium cyanamide see equation 1.

$$CaO + 3C \rightarrow CaC_2 + CO \quad (1)$$

The reaction of calcium carbide with water was discovered by Friedrich Wohler in (1986) equation 2.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2 \quad (2)$$

[10] said calcium carbide is use for production of calcium cyanamide. Calcium carbide reacts with nitrogen at high temperature to form calcium cyanmide equation 3.

$$CaC_2 + N_2 \rightarrow CaCN_2 + C \quad (3)$$

Reaction of water with calcium carbide is presented in equation 4.

$$\underset{\text{(Solid/Liquid)}}{CaC_2 + 2H_2O} = \underset{\text{(Aqueous/Gas)}}{Ca(OH)_2 - C_2H_2} \quad (4)$$

→ C_2H_2 + Ca $(OH)_2$. Is the basis of the industrial manufacture of acetylene and is the major industrial use of calcium carbide [11].

Application of energy for cooking, heating, lighting etc. mostly use kerosene, gas, electricity, wood and coal. Apart from wood and coal, all other mentioned are no longer easy to come by in terms of cost and availability. Petroleum products such as kerosene, gasoline and diesel account for 70-80% of total commercial energy consumption in Nigeria [12], so researching into energy use in agriculture is in the right direction. The objectives of this work are to develop a hover using calcium carbide as source of energy and compare its performance with kerosene lamp in brooding of day old chicks.

MATERIALS AND METHODS

Description of Brooding Hover

The brooding hover has the following components, two cylinders, (one for carbide and the other for water) case, nozzle, two regulators, (one for water and the other for acetylene gas), a spark and a handle. Water in the water cylinder drops on carbide through a water pipe and the reaction produce acetylene gas, which pass through a nozzle to a case where spark will be ignited to produce light and heat for brooding. The temperature in the brooding unit was

determined using wet and dry bulb thermometer, and the gas pressure was determined using pressure gauge. Figure 1 is representation of brooding hover.

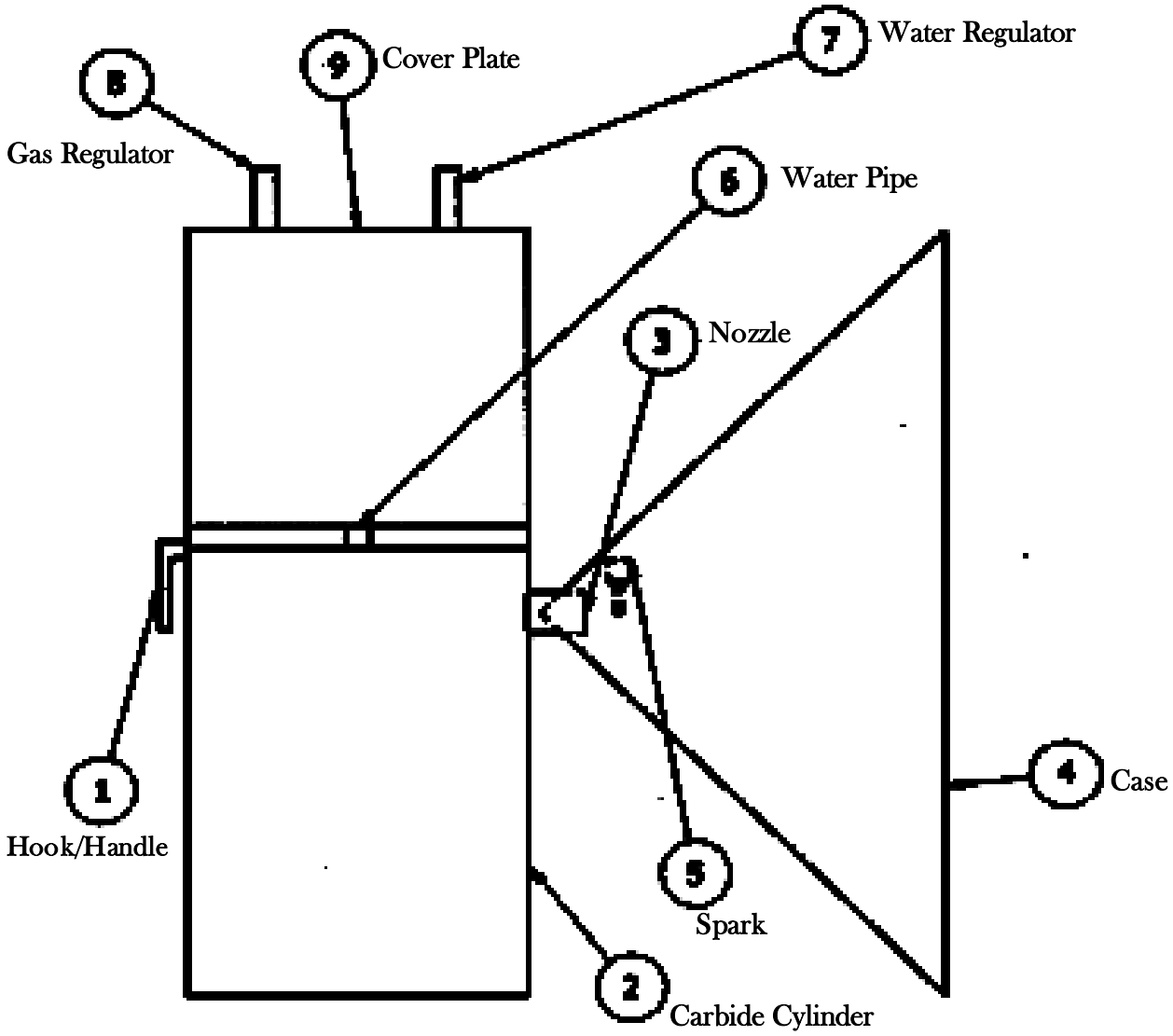

Fig. 1: Brooding Hover

Design of Bursting Force (BF)

Equation 5 [13] was used to determine bursting force;

$$BF = \text{Pressure} \times \text{Area} = p \times \frac{\pi}{4} \times d^2 \quad (5)$$

Design Resisting Force (RF)

Resistance Force (RF) was computed using equation 6 [13].

$$RF = Stress \times Resisting\ Area \quad (6)$$

Design of Cylindrical Shell Thickness

Since the cylindrical shell was subjected to a very high internal gas and fluid pressure, the walls of the cylinder must be made extremely thick; equation 7 is Dieter's equation for the thickness of the cylinder (Dieter, 1987).

$$x = p \times d/2\sigma t \tag{7}$$

$$d = \left(bv/\pi\right)^{13} \text{ or } v = 4/3 \times \pi r^3 \tag{8}$$

$$t = p \times d/2\sigma\mu$$

Design of Thickness of a Cylindrical Cover Plate

Equation 9 [13] was used to determine the thickness of the cylindrical cover plate.

$$t = \frac{4-16PR}{\sigma_u} \tag{9}$$

Where

P = Pressure inside the cylinder

R = inside radius of curvature of plate

σ_u = ultimate strength for the material of plate

Evaluation Method

One hundred and twenty (120) day old chicks were used for four (4) weeks, to evaluate the brooding performance of carbide/kerosene hovers. Sixty (60) were brooded using hover with calcium carbide and the other sixty (60) were brooded using kerosene lamp. The experiment was replicated three (3) times and the average for each brooding unit was recorded. The temperature distribution in the two brooding units was determined four (4) times daily and the average temperature taken, the feed intake on daily bases was recorded using weighing balance, water intake was recorded using measuring cylinder. Weight of each chick was recorded on weekly bases. The quantity of carbide and kerosene used on daily bases were measured and recorded. Death rate of each brooding unit was also recorded. Figure 2 is brooding boxes and Figure 3 is day old chicks in the two brooding units.

Figure 2: Brooding Box (a) Kerosene Lamp and (b) Carbide

Unit A

Unit B

Figure 3: Day Old Chicks in Brooding Units A and B

Mortality Rate Determination

Daily check for mortality in the brooding units was carried out and the findings recorded. Mean mortality rate of the chicks was determined using standard mean.

Determination of Kerosene/Carbide Quantity

Daily measurement of the quantity of kerosene and carbide consumed was carried out using a calibrated beaker for kerosene in litters and electric weighing balance for carbide in grammas. Quantity of fuel used in each brooding unit was computed on weekly bases.

Determination of Body Weight of Chicks

Body weight of day old chicks was measured in a carton using weighing balance and the weight of the carton subtracted from the total weight. Same method was applied to obtain weight for seven (7) day old chicks. Individual weight of the chicks was then measured after one week.

Determination of Consumption Ratio

Feed consumed by each chick in the two brooding units per week was measured and the weight gain by each chick measured after every one week. A standard feed conversion method was used to determine the ratio of feed consumed and the body weight gain by each chick for the period of four (4) weeks.

$$Feed\ Convertion\ Ratio = \frac{kg\ of\ feed\ consume\ by\ chicks}{kg\ body\ weight} \quad (10)$$

Determination of Temperature

Temperature was determined four times daily (interval of 6 hours) using dry and wet bulb thermometer.

RESULTS AND DISCUSSIONS

The performance evaluation of the device was tested using twenty (20) chicks each at day old for carbide hover and for kerosene lamp respectively for a period of 4 weeks and the experiment was replicated three times for the two brooding types.

Mortality rate of the chicks ranged from 5% – 8%. Carbide brooding was 5% while kerosene brooding was 8%. This is more efficient compared to [6] which recorded 12% mortality rate. However, the ANOVA result Table 1 showed that there was no significant difference in mortality rate between the two brooding types at p>5%.

Quantity of kerosene and carbide consumed per week were estimated in Naira (₦). Kerosene brooding cost ₦3825.25 while carbide cost ₦2868, this showed that carbide brooding is cheaper compared to kerosene lamp. ANOVA result Table 1 also showed that there was a significant difference in cost between the two energy types evaluated at p>5%. Farmers are therefore, advised to use brooding hover as energy source for small brooding in place of kerosene lamp because of its cheapness.

Body weight of chicks at different stages of growth were recorded for kerosene lamp and carbide hover. The weights were the same 0.414kg for lamp and 0.424 kg for carbide brooding. Mean body weight of 741.60gm and 771.62gm at the period of 4 weeks were recorded for kerosene lamp and hover respectively. This result is in agreement with that of [14] and [3] which has 795.20g and 800g as body weight. The slight difference between these experiments could be as a result in environmental and weather difference of the brooding areas. Figure 4 is a picture showing sizes of chicks at four (4) weeks old in the kerosene lamp and carbide hover.

Unit A

Unit B

Figure 4: Four (4) Weeks Old Chicks in Unit A & B

Feed conversion ratio (FCR) of the chicks in the two brooding types was determined. Lamp brooding had a mean of 1.6 while carbide brooding had a mean of 1.5. This finding is in agreement with [15] which recorded 1.50 feed conversion ratios. Carbide brooding has more efficient feed conversion ratio (FCR) than kerosene brooding though the ANOVA result showed no significant difference in the feed conversion ratio.

Temperatures generated in the brooding hover and Lamp brooding were in the same temperature range. ANOVA result showed no significant difference in temperature for the brooding types. Carbide hover had a mean of 31.0^{0}C and brooding lamp had 30.8^{0}C. This result compares favorably with standard recommended temperature for brooding [6]; [14] and [15]. This showed that brooding hover is a good energy source for chicks. Table is summary of operation.

Table 1: Tests of Hypotheses for Cost, Mortality, Temperature and Feed Conversion Ratio

Source	Ff	SS	MS	F-value	Pr>F
Cost	1	161130.1	161130.1	12.13863*	7.708647
Error	4	53096.63	13274.16		
Total	5	214226.7			
Mortality	1	16.66667	16.66667	1	
Error	4	66.66667	16.66667		
Total	5	83.333333			
Tempt	1	0.5166	0.5766	0.465695	
Error	4	4.9526	1.23815		
Total	5	5.5292			
FCR	1	0.002817	0.002817	0.982558	7.708647
Error	4	0.011467	0.002867		
Total	**5**	**0.014283**			

*Significant at $p \leq 0.05$

Table 2: Summary of Operation

Item	Lamp (Mean Value)	Hover (Mean Value)
Temperature	30.8^{0}C	31.0^{0}C
FCR	1.6	1.5
No of death	8.33%	5%
Qty of fuel used	28.35 liters	23.9kg
Cost of fuel	₦3827.25	₦2868

CONCLUSION

It can be concluded that.

1. There was significant difference in the cost of operations but no significant difference in temperature, mortality rate, and feed conversion rate between the two energy types considered.

2. Carbide hover was cheaper than kerosene lamp and should be used for brooding chicks.

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