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Preface

We would like to present, with great pleasure, the inaugural volume-10, Issue-5, May 2024, of a scholarly journal, *International Journal of Engineering Research & Science*. This journal is part of the AD Publications series *in the field of Engineering, Mathematics, Physics, Chemistry and science Research Development*, and is devoted to the gamut of Engineering and Science issues, from theoretical aspects to application-dependent studies and the validation of emerging technologies.

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Each article in this issue provides an example of a concrete industrial application or a case study of the presented methodology to amplify the impact of the contribution. We are very thankful to everybody within that community who supported the idea of creating a new Research with IJOER. We are certain that this issue will be followed by many others, reporting new developments in the Engineering and Science field. This issue would not have been possible without the great support of the Reviewer, Editorial Board members and also with our Advisory Board Members, and we would like to express our sincere thanks to all of them. We would also like to express our gratitude to the editorial staff of AD Publications, who supported us at every stage of the project. It is our hope that this fine collection of articles will be a valuable resource for *IJOER* readers and will stimulate further research into the vibrant area of Engineering and Science Research.

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The Effect of Perinatal GBS Screening and IAP on Maternal and Infant Prognosis

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Abstract—

Objective: *To investigate the effect of perinatal Group B Streptococcus (GBS) infection and intrapartum antibiotic prophylaxis (IAP) regimen on maternal and infant clinical outcome.*

Methods: *From January to December 2023, 626 GBS-positive and 2565 GBS-negative, gestation 35-37 weeks pregnant women were included in the observation and the control groups respectively. We compared the outcomes of the maternal and infant between the two groups.*

Results: *The preterm birth rate and postpartum hemorrhage rate in the observation group were significantly lower than that in the control group. However the incidence of preterm rupture of membranes, the incidence for "placenta pathological examination" critically evaluated by "after- However the incidence of preterm rupture of membranes, the incidence for "placenta pathological examination" critically evaluated by "after- delivery check protocol" and neonatal clinical sepsis in the observation group was significantly higher than that of the control group. There was no statistically significant difference in terms of delivery methods, the incidence of macrosomia, the incidence of neonatal 1'Apgar score. There was no statistically significant difference in terms of delivery methods, the incidence of macrosomia, the incidence of neonatal 1'Apgar score ≤7 and neonatal pneumonia between the two groups.*

Conclusions: *The standardized maternal GBS screening and intrapartum antibiotic prophylaxis (IAP) programme adopted at our hospital was effective in reducing adverse maternal and neonatal outcomes.*

Keywords— Group B Streptococcus (GBS), Neonatal pneumonia, neonatal clinical sepsis, Intrapartum antibiotic prophylaxis(IAP).

I. INTRODUCTION

GBS, also known as Streptococcus lactis, is the leading cause of infection during pregnancy, premature birth and neonatal infections. It is also a common species found in the vagina and rectum of women. Its presence is intermittent, temporary and persistent [1]. However, reproduction in the female vagina is a high-risk indicator for neonatal diseases and premature birth [2]. Normally, there is a balance between the microflora in the vagina and the host's environment. However, if the level of oestrogen rises in the pregnant woman's body, advantageous bacteria such as vaginal glycogen and lactobacilli will proliferate, resulting in a disturbance of the originally balanced microflora in the organism, which is most obvious in the late stage of pregnancy. The edema of the vaginal mucosa and other factors can easily induce GBS infection in the genital tract, leading to adverse pregnancy outcomes and threatening the safety of the newborn.[3] GBS infection is often associated with sepsis, urinary tract infections, endometritis, and fetal infections in pregnant women. Failure to detect GBS in the antenatal period may increase the risk of infection in both the mother and the newborn[4]-[6]. The most common type of GBS infection is early-onset group B streptococcus (EOGBS) in newborns, which manifests itself as an infection within 7 days of birth and is characterized by respiratory symptoms and pneumonia[7]. The incidence of vaginal/rectal GBS in pregnant women is 10-30% [8]. The prevalence of GBS in low-income countries, Africa, and black women is higher, and the incidence of neonatal disease is higher, too [9]-[10].

There are approximately 6,000,000 preterm births and more than 500,000 neonatal deaths due to preterm births worldwide each year.

In order to understand the relationship between GBS infection and pregnancy outcomes, this article uses the GBS detection results of pregnant women in the third trimester to study the impact of GBS bacteria on pregnancy outcomes and neonatal infections to provide clinical reference

II. MATERIALS AND METHODS

2.1 Research subjects:

A total of 3191 singleton pregnant women who gave birth in our hospital from January to December 2023 were analyzed. During the antenatal check-up period between 35 and 37 weeks of pregnancy, vaginal and rectal secretions of pregnant women are collected for DNA testing of group B streptococci. At the same time, vaginal and rectal secretions from pregnant women with threatened preterm labor are also tested for Group B Streptococcus DNA. All pregnant women were divided into observation group (infected with GBS and full IAP, 624 cases) and control group (not infected with GBS, 2565 cases) according to whether they had vaginal GBS infection or not. According to the indications for placental pathological examination at the Department of Obstetrics and Gynecology of Kiang Wu Hospital, including factors such as fever during delivery, preterm birth, maternal or fetal adverse outcomes, the placentas of the two groups of patients after delivery were selectively sent for pathological examination, with 52 cases in the observation group and 125 cases in the control group. The average age of the observation group was 29.72 ± 3.12 years old, the gestational age was 35~41+4 weeks, and the average gestational age was 38.15 ± 2.12 weeks. Primiparous women accounted for 146 cases, and multiparous women accounted for 478 cases. The proportion of vaginal delivery was 66.67%, the proportion of cesarean section was 31.73%, and the proportion of assisted vaginal delivery was 1.6%. The average age of the control group was 30.34 ± 2.82, the gestational age was 28~41+4, and the average gestational age was 38.22 ± 3.12 weeks. Primiparous women accounted for 635 cases and multiparous women accounted for 1930 cases. The proportion of vaginal delivery was 64.17%, the proportion of cesarean section was 34.31%, and the proportion of assisted vaginal delivery was 1.52%. There were no differences between the two groups. After birth, the vital signs were monitored, neonatal pneumonia or neonatal pneumonia was diagnosed according to the diagnostic criteria of the 4th edition of "Practical Neonatology" [11], and the proportion of neonatal infections among the two groups of pregnant women was compared.

2.2 Research methods:

2.2.1 Specimen collection:

During prenatal check-up, swab specimens from pregnant women between 35 and 37 weeks of pregnancy are collected according to the 2002 CDC guidelines. Insert a sterile cotton swab into the lower 1/3 of the vagina and rotate it once to collect vaginal secretions. Use the same swab to insert it into the anal sphincter at a position 2 to 3 cm and rotate it to collect rectal secretions. Put the swab back into the sterile swab tube, seal it and send it for inspection. GBS DNA testing was performed using the BD Max system.

The placental culture method is to tear open the chorionic membrane and amniotic membrane under sterile conditions after delivery of the placenta, and wipe the chorion or amniotic membrane several times with a sterile spatula. Put the swab back into the sterile swab tube, seal and send for inspection for bacterial culture.

2.2.2 GBS DNA detection:

Place the swab after collecting the specimen into 5ml of Lim broth (Todd-Hewitt broth with 10ug/ml colistin and 15ug/ml nalidixic acid), incubate at 37 degrees for 18-24 hours, and then use The BD MAX system uses fully automated real-time polymerase chain reaction (PCR) technology for GBS DNA detection.

2.2.3 IAP:

According to the RCOG 2017 guidelines[12]: for preterm pregnant women with unknown GBS status, vaginal and rectal GBS samples should be taken on admission and treated with penicillin; preterm pregnant women in labour should be treated with penicillin until delivery, and preterm pregnant women who are not in labour should stop penicillin treatment and wait for the results of the GBS test. If GBS-positive, or if the result is not available before the onset of labour, IAP treatment is started at the time of labour; if GBS-negative, there is no need for prophylaxis. If the pregnancy is not in labor but the pregnant woman reaches 35 to 37 weeks or the GBS- negative result exceeds 5 weeks, GBS screening should be performed again. Pregnant

women with known GBS- positive preterm labor should receive penicillin treatment for 48 hours during tocolysis, and IAP treatment during labor until delivery. Adequate IAP is defined as delivery more than 4 hours after intravenous penicillin, or ampicillin, or cefazolin. Inadequate IAP is defined as treatment with penicillin or benzylpenicillin, or cefazolin for less than 4 hours, or treatment with other antibiotics (e.g., clindamycin, vanillin). No IAP means that no antibiotics were used. In our hospital, we follow the RCOG guidelines for IAP in GBS DNA-positive pregnancies, with antibiotic prophylaxis after rupture of membranes or after labour, and the antibiotic of choice is Cefazolin. For elective caesarean section, cefazolin is routinely used for prophylaxis.

2.3 Statistical analyses

SPSS 22.0 statistical software was used for data processing. Measures of normal distribution were expressed as mean±standard deviation (x±s), count data were expressed as number of cases and percentage (%), and comparisons between groups were made using the X^2 test. $p<0.05$ was taken as the difference was statistically significant.

III. RESULTS:

3.1 Detection of Group B Streptococcal Infections in Pregnant Women and Completion of IAP

Of the 3191 pregnant women, 626 were GBS positive (19.62%) and 2565 were negative (80.38%).Of the 626 GBS positive pregnant women, 624 completed adequate IAP according to the 2017 RCOG guideline, and 2 had no IAP after delivery by women who had a normal labour on admission to the hospital. Adequate IAP reached 99.36% (624/626).

3.2 Comparison of the mode of delivery between the two groups of pregnant women

During January to December 2023, total number of singleton pregnancies delivered in our hospital was 3191, out of which 2565 were GBS negative (control group), with 64.17% (1646/2565) of normal delivery rate, 34.31% (880/2565) of caesarean section rate and 1.52% (39/2565) of assisted delivery rate. There were 624 cases of positive GBS at the same time in our hospital (observation group), with a positive rate of 19.61% (626/3192); the rate of normal delivery was 66.67% (416/624), cesarean section rate was 31.73% (198/624), and assisted delivery rate was 1.6% (10/624). There was no statistically significant difference in the mode of delivery between the two groups (P>0.05).

3.3 Comparison of adverse birth outcomes between the two groups of pregnant women

In the observation group, the incidence of preterm delivery was 0.8% (5/624), preterm rupture of membranes was 18.43% (115/624), postpartum haemorrhage was 3.04% (19/624), macrosomia was 2.72% (17/624), and the incidence of newborns with 1'APGAR ≤ 7 points was 1.92% (12/624). In the control group, the preterm birth rate was 3.90% (100/2565), the preterm rupture of membranes rate was 11.93% (306/2565), the postpartum haemorrhage rate was 5.26% (135/2565), the birth rate of macrosomia was 2.03% (52/2565), and the incidence of 1'APGAR ≤7 points in newborns was 2.33% (60/2565). The rates of preterm delivery and postpartum haemorrhage in the observation group were lower than those in the control group, and the differences were statistically significant (P<0.05). However, the incidence of preterm rupture of membranes and the incidence of newborns with 1'APGAR≤7 were higher in the observation group than in the control group, and the difference was statistically significant (P<0.05). The difference in the incidence of macrosomia was no statistically significant (P>0.05), as shown in Table 1.

TABLE 1
COMPARISON OF DELIVERY AND NEONATAL OUTCOMES BETWEEN THE TWO GROUPS OF PREGNANT WOMEN

	Observation group n (%)	Control group n (%)	X^2 value	P value
Premature births	5(0.8%)	100(3.90%)	6.723	0.008
Premature rupture of membranes	115(18.43%)	306(11.93%)	5.002	0.021
Postpartum hemorrhage	19(3.04%)	135(5.26%)	6.237	0.009
Macrosomia	17(2.72%)	52(2.03%)	0.813	0.323
1’APGAR≤7分	12(1.91%)	60(2.33%)	0.394	0.53
Neonatal pneumonia	39(6.23%)	146(5.69%)	0.27	0.6
Neonatal infection	57(9.11%)	125(4.87%)	16.75	0

3.4 Pathological and bacterial culture results of placenta in the two groups

In the 52 cases of observation group, 34 cases of placenta umbilical cord inflammation were examined after delivery. Among them, there were 18 cases of placenta umbilical cord inflammation alone, 7 cases of placenta umbilical cord inflammation + premature rupture of membranes, 5 cases of placenta umbilical cord inflammation + fever, and 4 cases of placenta umbilical cord inflammation + premature rupture of membranes + fever. All placentas sent for pathological examination were negative for bacterial culture. There were 0 cases of confirmed chorioamnionitis, but 9 cases of placenta pathology showed inflammation with fever, which was presumed to be chorioamnionitis. In the control group, 125 cases of postnatal placenta pathology were examined, and there were 64 cases of placenta umbilical cord inflammation, among which 19 cases of placenta pathology showed inflammation with fever, which was deduced to be chorioamnionitis. All placentas sent for pathological examination were negative for bacterial culture. Comparison of placenta umbilical cord inflammation and placenta umbilical cord inflammation with fever between the two groups, the observation group had a higher incidence rate, and the difference was statistically significant (P<0.05), shown in Table 2.

TABLE 2
COMPARISON OF PLACENTAL BACTERIAL CULTURE AND PLACENTAL PATHOLOGY CASES (%) BETWEEN THE TWO GROUPS

	Observation group	Control group	X^2 value	P value
Delivery evaluation was normal and pathology was not sent	574（91.7%）	2440（95.1%）	10.676	0.001
After assessment, send for pathological analysis	52（8.3%）	125（4.9%）	2.541	0.001
Placenta and umbilical cord inflammation	34(65.4%)	64(51.2%)	6.19	0.013
Placental pathology showed inflammation accompanied by fever	9(17.3%)	19(15.2%)	2.838	0.092
Bacterial culture positive	0（0%）	0（0%）		
Confirmed HCA	0（0%）	0（0%）		

3.5 Neonatal outcomes

A total of 3,191 newborns were delivered by singleton pregnant women in 2023. 626 newborns in the GBS-positive group developed neonatal pneumonia in 6.23%.The incidence of neonatal pneumonia between the GBS- positive group and the negative group had a *P* value >0.05, and there was no statistical difference. Complicated neonatal infections accounted for 9.11%, and all were diagnosed as clinical infections [13], that is, no positive bacteria were cultured in the microbiological culture of the neonatal blood laboratory. *The P* value of the incidence rate of neonatal infection between the GBS positive group and the negative group was <0.05, and there was a statistical difference. From the review, 37 of the 57 neonatal infection cases had both clinical manifestations and elevated C- reactive protein. The other 20 cases had no clinical symptoms and only had elevated C- reactive protein.

IV. DISCUSSIONS

The GBS positivity rate in our hospital was 19.46%. In the 1970s, GBS was an important cause of perinatal infection and neonatal death. The implementation of perinatal GBS infection prevention guidelines can significantly reduce the rate of neonatal EOGBS infection, for example, the rate of EOGBS infection in the United States, from 0.4% in 1970, gradually reduced to 0.18% in 1990, and then dropped to 0.023% in 2015[14]. In China, due to the lack of comprehensive screening of pregnant women for GBS, the p roportion of newborns with EOGBS is still high, reaching 0.94%[15]. CDC guidelines recommend screening pregnant women for GBS at 35-37 gestation and IAP in positive pregnant women. However, there are still 2-10% of pregnant women who do not have IAP due to false-negative screening[16]. In recent years, our hospital has implemented **GBS** infection prevention strategies for perinatal pregnant women in accordance with RCOG 2017 and CDC guidelines. The IAP rate of positive pregnant women is as high as 99.36%.

There was no significant difference in the proportion of vaginal delivery, caesarean and assisted deliveries between the observation group and the control group. **GBS** was positive and predisposed to premature rupture of membranes, chorioamnionitis and endometritis. Most of the patients in the observation group underwent IAP to avoid infection during pregnancy. In this study, premature rupture of membranes, placenta umbilical cord inflammation and placenta umbilical cord

inflammation with fever were significantly higher in the observation group than in the control group, but the rates of preterm delivery and haemorrhage were significantly lower. Meanwhile, the preterm birth rate in the observation group was also slightly lower than the 1.21% reported in the 2017 meta-analysis[17]. This may be due to the fact that intrauterine infections are not easily detected at the initial stage and most of the control group was not given prophylactic antibiotics, which led to contraction weakness and postpartum haemorrhage. There is no difference in the prevalence of histological chorioamnionitis (HCA) in premature infants between the GBS - positive group and the GBS-negative group [18]. Although the rates of placenta umbilical cord inflammation and placenta umbilical cord inflammation with fever were significantly higher in the observation group than in the control group, there were no cases of confirmed chorioamnionitis in all the placentas sent for pathological analysis. This may be related to the high rate of standardised and adequate IAP in our hospital.

Similar to domestic and foreign literature reports, there was no statistically significant difference in the mode of delivery and the rate of macrosomia between the observation group and the control group[19]-[20]. The proportion of neonates born with 1' APGAR ≤7 was not statistically significant compared to the control group. It has been reported in the literature[21]-[23] that the incidence of neonatal respiratory distress is higher in GBS-positive cases without IAP than in negative cases, suggesting that IAP is effective in improving poor neonatal outcome. In the present study, none of the neonates born to the two groups of pregnant women had positive blood cultures, and no neonate was diagnosed with EOGBS. There was no difference in the incidence of neonatal pneumonia between the GBS-positive and negative groups, but the incidence of concurrent neonatal infections (clinical type of infection) was higher in the observation group than in the control group. From the 57 neonatal infections reviewed, 37 cases had both clinical manifestations and elevated C-reactive protein. The other 20 cases had no clinical signs and only elevated C-reactive protein. This shows that we are a little more lenient in the diagnosis and treatment of GBS-positive neonates, and we may consider introducing the Neonatal Infection Scale (NIS)[27] into our clinical practice in the future.

GBS is a rare infection in immunocompetent adults but carries a high risk in newborns with immature immune systems. 40-70% of mothers carrying GBS will infect their newborns, and 1-2% of these newborns will become infected. When GBS comes into contact with the amniotic cavity or placenta, amnionitis or chorioamnionitis may occur, leading to preterm labour and stillbirth[24]. A study on how GBS crosses the placenta barrier to cause chorioamnionitis when it infects the chorionic villus found that GBS can adhere to and invade chorionic villus and amniotic epithelial cells[25]. Chorioamnionitis can cause direct fetal lung damage[26], without the need for bacterial invasion of the lungs.

Our hospital currently recommends that pregnant women be screened for Group B Streptococcus at 36 to 37 + 6 weeks of gestation according to ACOG 2019 guidelines, with the goal of reaching the 5- week window period to 41 weeks of gestation; if the test exceeds 5 weeks, repeat testing is required [28]. In the future, it is planned to further study the 57 cases of neonatal infection, their mothers' medical history, delivery process and maternal infection status

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Development of a Specie-specific Bird Deterrent System using Birds Classifications by Convolutional Neural Network (CNN) Model

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Abstract— *A trained convolutional neural network (CNN) model was developed in this work for classification of birds that visit rice farms into harmful Sparrows or beneficial insectivorous birds, and the classification used in activating efficient pest bird deterrence. Different images of the prevalent pest sparrow were captured by high resolution camera, and used as datasets for the training of the CNN model for the pest bird identification. Since, 98% of sparrow birds are grain eaters and harmful to a rice farm, 2,000 images of different sparrow birds were used together with the 419 different images of the prevalent Sparrows found in the rice farms as datasets for the training of the CNN model in Google Colab platform. A suitable algorithm was developed that uses this birds classification for recognizing the birds that visit the farm as pest Sparrows or otherwise. A bioacoustics deterrent system that uses the recorded sound of a local predator of Sparrows was developed for sparrow-pests. This sound was activated to broadcast the predator sound through the speakers to scare away the birds once Sparrows are sighted in a rice farm or nearby surroundings. However, if the sighted bird is recognized as not a Sparrow, no sound will be activated, so that the beneficial birds will be allowed do their biological insect-pest control in the rice farm. The algorithm can also be used by researchers and teachers in agriculture-related disciplines to teach bird classification in a rice farm.*

Keywords— Convolutional Neural Network, Bird Classifications, Sparrow-pests, Beneficial Birds, Integrated pest control, Rice Farm.

I. INTRODUCTION

Two thirds of the Nigerian populace get their livelihood from agriculture; a major source of income and feeding for most developing nations. Presently, it contributes well over a fifth of Nigeria's gross domestic product (GDP) [1]. Pest infestations in farms seem to be a major part of the numerous problems faced by the agricultural sector [1-8]. Birds are the most destructive pests to in crops farms, and total loss of farm produce can ensue if birds are not controlled [2]. While Java Sparrows are the most destructive bird pests for rice in the farm, there are other birds which feed on insects that attack the rice plants; thus performing biological pest control [2-7]. The different bird deterrent solutions available are not specific in the type of birds to be scared away and some do not deploy the right predator for such birds. With non-selective scaring away of birds, the pest-birds are scared away as well as some of the useful insectivorous birds. These insectivorous birds, by feeding on insects and other rice pests, effect biological control of the pest population; increasing the productivity of rice. Hence a device that can be used for detecting the harmful birds and scare them away while leaving the beneficial ones to remain in the farm will be a welcome development.

Unmanned Aerial Vehicles (UAVs) or drones has be used in capturing, processing, and analyzing images for farm pest management, but have limitations like untimely reach to remote spots, security-related ban, altitude reach limitation and scaring of harmful and useful birds alike [3]. Additional pollution, wind opposition and non-conservation issues arise when chemical deterrence is used with the drones [9]. Drones equipped with multispectral, thermal and visible cameras have been deployed for monitoring in agriculture, but challenges of drone architecture, wind influence on flight, low GPS accuracy have been reported [10]. Researchers [11] have been carried out land area estimation and classification with drone and satellite data via

machine learning. Machine learning has also applied image recognition to vineyard and agricultural objects with 89.6% accuracy [12]. A bird repellent system based on bird features identification-image processing has been deployed with Raspberry pi, a sound speaker on rice farm [13]. The device utilized a model trained separately using Haar features, HOG (Histogram of Oriented Gradients) and LBP (Local Binary Patterns) and Python and Open CV library software. The system achieved 76% highest accuracy from Harr, 72% from LBP and 27% from HOG, but did not specify the particular birds to be repelled. Both pest birds and beneficial birds were scared away from the rice farm using the same sound. The cognitive abilities of birds make them to attach sounds to previous experiences. Those birds that have not had an ugly experience associated with such sound would return to the farm and may not be scared away by such sound again. This work could not guaranty increase in rice yield since both the harmful and beneficial birds would be scared away and the insect pests would attack the rice plant without any resistance.

CNN can learn highly abstracted features, especially spatial data [14] and once trained can correctly identify the features of an input image. CNN affords comparatively easier implementation because of the reduction of the number of trainable network parameters via the use of the weight sharing features and ability of the classification and feature extraction layers to learn together. Intermediate terms calculation avoidance are consequently enabled in the CNN [15], and the associated over-training of the network and its consequent poor predictions overcome. The inter-layers transfer functions weights are fine-tuned by feeding the errors backwards using backpropagation algorithm. CNN needs a capable robust programming language. Python language suits CNN implementation because of its readability and dense syntax. Google Colab platform is also suitable for large image data storage, recognition and classifications. The Raspberry pi 2 is a device (Small Computer) that was used for the Sparrow bird image preprocessing and video streaming [16]. This research work aims at using artificial intelligence and machine learning to develop a convolutional neural network (CNN) model for classification of birds into harmful Sparrows or beneficial insectivorous birds. Such classification will be used to develop an efficient deterrent system for scaring of harmful sparrow-birds away from the rice farm using the sound of the predator of the Sparrow. This will make the birds to fly away from the rice farm since their cognitive abilities will match the predator sound with ugly experiences in the past.

II. MATERIALS AND DATA COLLECTION

2.1 Materials:

The materials used in the work are as follows:

2.1.1 Cameras:

These were strategically positioned in the farm to capture the different images of the sparrow-birds providing the much needed image datasets for the training of the convolutional neural network. High resolution digital 4K cameras were used. A Sparrow image captured by the camera is shown in Plate 1 and that of the different sparrow-birds obtained from different internet sources shown in Plate 2. These images were combined and preprocessed by Raspberry pi using python language to convert them into the Joint Photographic Group (JPG) image format and 3 dimensions (224, 224, 3) to form the dataset for the CNN training.

PLATE 1: Image of Sparrow bird captured in a Rice Farm

2.1.2 Raspberry pi 2:

This was used for the Sparrows image preprocessing and video streaming. It operated on Raspbian operating system; a version of Linux and a modified version of Debian. Python language was used.

2.1.3 Training Method:

Back-propagation (BP) training method was used. It reduced the volume of data (nodes) needed and the cost involved. This training was repeated until either the specified error rate was obtained or the number of training cycles (Epochs) was reached.

PLATE: 2: Images of Different Harmful Sparrow Birds from Other Locations (Source: Internet).

2.1.4 Python Language:

This was used to train the model in Google Colab platform for rice bird recognition and classifications.

2.2 Data Collection:

Data collection was divided into two stages:

1. The use of questionnaires to identify the most dangerous rice bird in the selected rice farms. In the course of this research, fifty rice farmers were interviewed and five rice farms were selected in Nenwe community of Aninri local

government area in Enugu state, Nigeria. The prevalent pest-birds for rice farms in Nenwe (6.1328°N, 7.5396°E) was identified using the questionnaires other vital information including the bird's local predator was also extracted.

2. Obtaining the different images of the selected rice farm and Sparrows with camera and download of more Sparrow images from the internet. The different images of the sparrow-birds and the selected rice farms were captured by the camera.

2.3 Development of the Proposed Deterrent System

The development of the proposed deterrent system is divided into 4 sub-headings as follows:

2.3.1 Image Pre-processing for Development of Dataset for Model Training

The data set for model training was generated from the algorithm in the Flowchart in Figure 1; derived from the steps below:

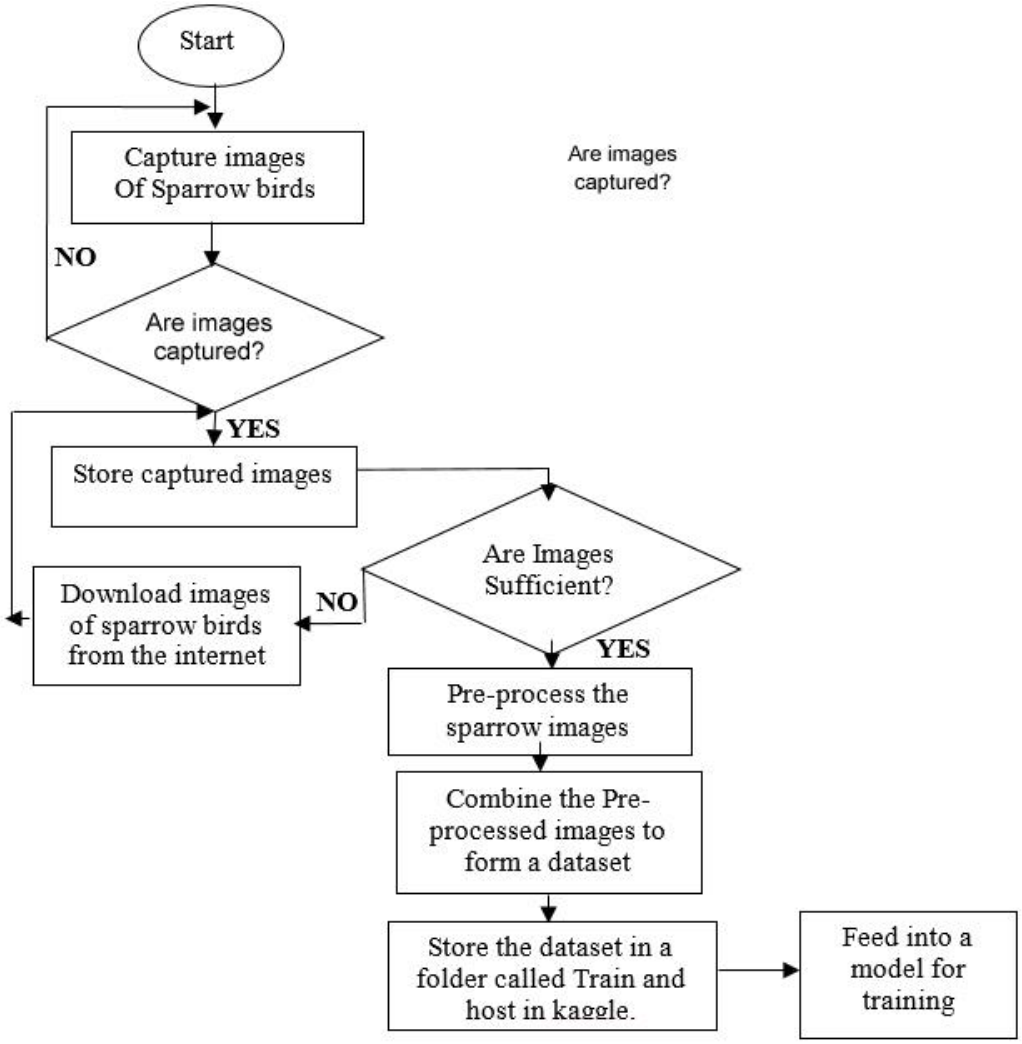


FIGURE 1: Flowchart for Building of Training Dataset

Step 1: Start

Step 2: Capture images of sparrow

Step 3: Are images of sparrow birds captured by camera

No; Go back to step 2

Yes; Go to step 4

Step 4: Store captured images

Step 5: Are images of the sparrow enough?

No; Go to Step 6

Step 6: Download images of sparrow bird from the internet

Go back to step 4

Go back to step 5

Yes; Go to step 7

Step 7: Pre-process the sparrow images

Step 8: Combine the pre-processed images of the sparrow to form a dataset

Step 9: Dataset is stored in a folder called train

Step 10: Host the train folder on kaggle for easy and faster training of the model

2.3.2 Development of the CNN Model:

A pre-trained high efficient model called efficientnetb5 was frozen of its weight and used in a process of transfer intelligence as a foundation for the new CNN model. The output of the pre-trained model was removed and the convolutional base for the new model was introduced so as to capture the image format for the developed model and the dense layer was added so as to obtain an output for the developed model. The model development algorithm is as in the steps below and as shown in the flow chart in Figure 2.

Step 1: Start

Step 2: Search for pre-trained model in tensor flow

Step 3: Is the EfficientNetB5 model found?

No; Go back to step 2

Yes; Go to step 4

Step 4: Download the efficientnetb5 pre-trained model

Step 5: Prepare a dataset for model training

Step 6: Is dataset prepared?

No; Go back to step 5

Yes; Go to Step 7

Step 7: Data verification

Step 8: Is data verified?

No; Go back to step 7

Yes; Go to Step 9

Step 9: Create convolutional base

Step 10: Freeze the pre-trained model's parameters

Step 11: Is the efficientnetb5 frozen?

No; Go back to step 10

Yes; Go to step 12

Step 12: Add dense layer on top of the frozen efficientnetb5

Step 13: Compile the model

Step 14: Train the Model

Step 15: Evaluate the Model

Step 16: Is the model efficient?

No; Go Step 17

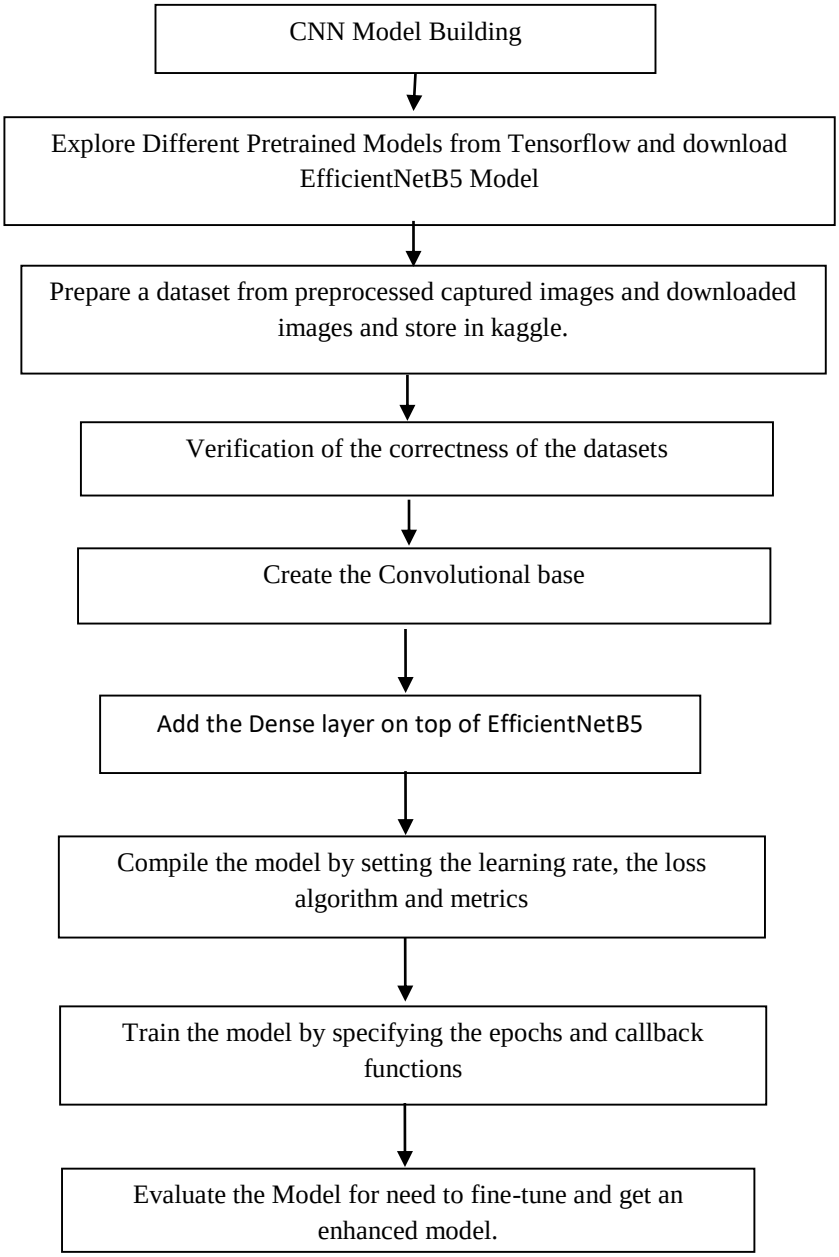


FIGURE 2: Building Block of a Convolutional Neural Network (CNN) Model

Step 17: Fine tune the model

Go back to step 14

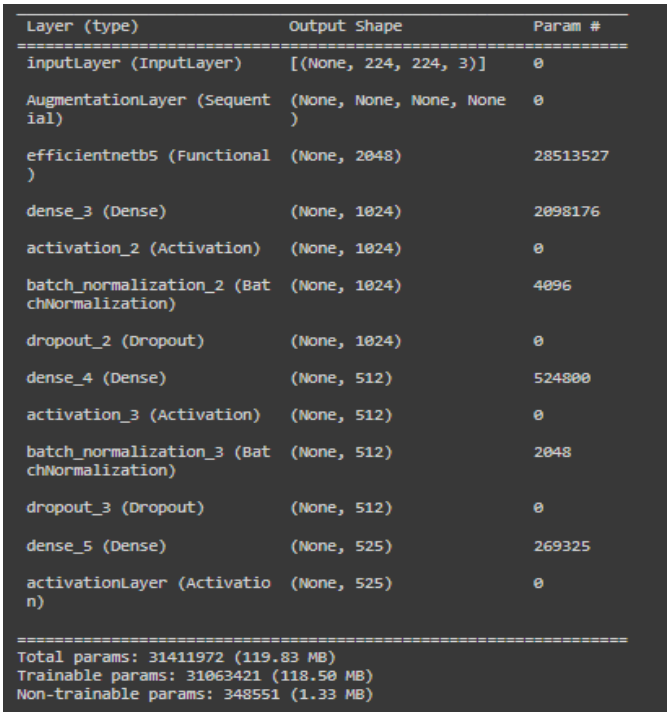
Go to step 15

Go to step 16

Yes; Go to step 18

Step 18: Store the Model in Kaggle

Figure 3 shows the sequence of the enhanced convolutional neural network (CNN) model developed in the course of this research with increased number of trainable parameters due to augmentation, dropout and unfreezing of the weights of the pre-trained efficientnetb5 model used as the foundation of the building of this model.



Layer (type)	Output Shape	Param #
inputLayer (InputLayer)	[(None, 224, 224, 3)]	0
AugmentationLayer (Sequential)	(None, None, None, None)	0
efficientnetb5 (Functional)	(None, 2048)	28513527
dense_3 (Dense)	(None, 1024)	2098176
activation_2 (Activation)	(None, 1024)	0
batch_normalization_2 (BatchNormalization)	(None, 1024)	4096
dropout_2 (Dropout)	(None, 1024)	0
dense_4 (Dense)	(None, 512)	524800
activation_3 (Activation)	(None, 512)	0
batch_normalization_3 (BatchNormalization)	(None, 512)	2048
dropout_3 (Dropout)	(None, 512)	0
dense_5 (Dense)	(None, 525)	269325
activationLayer (Activation)	(None, 525)	0

Total params: 31411972 (119.83 MB)
Trainable params: 31063421 (118.50 MB)
Non-trainable params: 348551 (1.33 MB)

FIGURE 3: Enhanced CNN Model Showing Inputs and Output Layers with More Trainable Parameters

2.3.3 Training of the Developed CNN Model with Training Datasets

The developed model was trained with the dataset developed in section 2.1 to determine how well the model will be able to classify birds in the rice farm into harmful sparrow and beneficial birds. This training was carried out in Google Colab platform with epoch of 20 and 2419 preprocessed images of sparrow birds so as to obtain improved training and validation accuracies at highly reduced losses.

2.3.4 Development of an Efficient Algorithm for the deterrent System

The efficient algorithm for bird deterrent was developed using the developed algorithm as follows:

Step 1: Start

Step 2: Monitor the trained enhanced CNN model

Step 3: Is any sparrow bird identified by the model?

No; Go back to step 2

Yes; Go to step 4

Step 4: Classify the sparrow bird to identify the right predator

Step 5: Is the sparrow bird classified?

No; Go back to step 5

Yes; Go to step 6

Step 6: Simulate the predator sound on the speaker to scare away the bird

Go back to step 2.

The flow chart for the algorithm is presented in Figure 4.

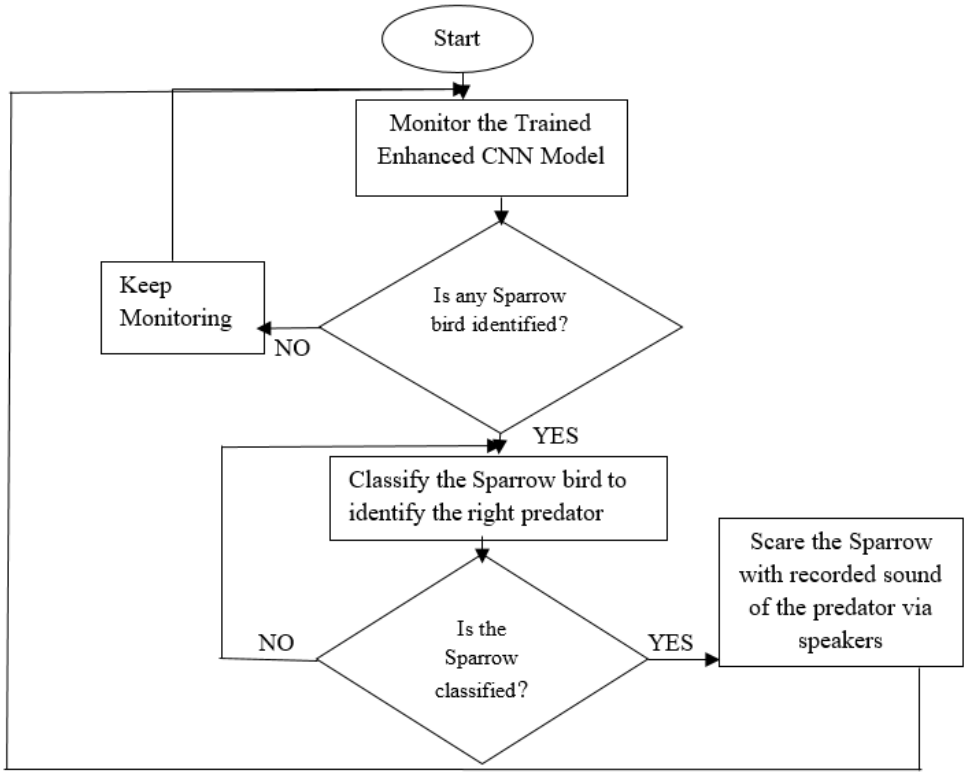


FIGURE 4: Flow Chart for Bird Deterrent

III. RESULTS AND DISCUSSION

3.1 CNN Training and Validation Accuracies and Losses

The result obtained from the training of the developed enhanced CNN model of Figure 3 for bird classification bird type found in the rice farms are shown in Figures 5 and 6 and also in Table 1. The losses decreased with increasing Epoch, while the accuracy increased with the increasing Epoch. This showed that the trained enhanced CNN model has a high likelihood of classifying the Sparrow images correctly.

```
Epoch 1/20
2419/2419 [==============================] - 1135s 439ms/step - loss: 5.7628 - accuracy: 0.0573 - val_loss: 4.0439 - val_accuracy: 0.2731 - lr: 1.0000e-05
Epoch 2/20
2419/2419 [==============================] - 1059s 438ms/step - loss: 4.0508 - accuracy: 0.2440 - val_loss: 2.6073 - val_accuracy: 0.5829 - lr: 1.0000e-05
Epoch 3/20
2419/2419 [==============================] - 1056s 437ms/step - loss: 2.8842 - accuracy: 0.4573 - val_loss: 1.5923 - val_accuracy: 0.7657 - lr: 1.0000e-05
Epoch 4/20
2419/2419 [==============================] - 1055s 436ms/step - loss: 2.0255 - accuracy: 0.6284 - val_loss: 0.9710 - val_accuracy: 0.8484 - lr: 1.0000e-05
Epoch 5/20
2419/2419 [==============================] - 1055s 436ms/step - loss: 1.4528 - accuracy: 0.7362 - val_loss: 0.6386 - val_accuracy: 0.8899 - lr: 1.0000e-05
Epoch 6/20
2419/2419 [==============================] - 1055s 436ms/step - loss: 1.0776 - accuracy: 0.8004 - val_loss: 0.4567 - val_accuracy: 0.9139 - lr: 1.0000e-05
Epoch 7/20
2419/2419 [==============================] - 1052s 435ms/step - loss: 0.8295 - accuracy: 0.8440 - val_loss: 0.3471 - val_accuracy: 0.9242 - lr: 1.0000e-05
Epoch 8/20
2419/2419 [==============================] - 1052s 435ms/step - loss: 0.6563 - accuracy: 0.8733 - val_loss: 0.2818 - val_accuracy: 0.9387 - lr: 1.0000e-05
Epoch 9/20
2419/2419 [==============================] - 1051s 435ms/step - loss: 0.5369 - accuracy: 0.8946 - val_loss: 0.2401 - val_accuracy: 0.9459 - lr: 1.0000e-05
Epoch 10/20
2419/2419 [==============================] - 1053s 435ms/step - loss: 0.4492 - accuracy: 0.9087 - val_loss: 0.1992 - val_accuracy: 0.9531 - lr: 1.0000e-05
Epoch 11/20
2419/2419 [==============================] - 1053s 435ms/step - loss: 0.3802 - accuracy: 0.9227 - val_loss: 0.1895 - val_accuracy: 0.9562 - lr: 1.0000e-05
Epoch 12/20
2419/2419 [==============================] - 1054s 436ms/step - loss: 0.3254 - accuracy: 0.9331 - val_loss: 0.1751 - val_accuracy: 0.9554 - lr: 1.0000e-05
Epoch 13/20
2419/2419 [==============================] - 1052s 435ms/step - loss: 0.2811 - accuracy: 0.9412 - val_loss: 0.1577 - val_accuracy: 0.9608 - lr: 1.0000e-05
Epoch 14/20
2419/2419 [==============================] - 1050s 434ms/step - loss: 0.2468 - accuracy: 0.9486 - val_loss: 0.1558 - val_accuracy: 0.9604 - lr: 1.0000e-05
Epoch 15/20
2419/2419 [==============================] - 1050s 434ms/step - loss: 0.2149 - accuracy: 0.9547 - val_loss: 0.1440 - val_accuracy: 0.9642 - lr: 1.0000e-05
Epoch 16/20
2419/2419 [==============================] - 1050s 434ms/step - loss: 0.1895 - accuracy: 0.9599 - val_loss: 0.1413 - val_accuracy: 0.9646 - lr: 1.0000e-05
Epoch 17/20
2419/2419 [==============================] - 1055s 436ms/step - loss: 0.1687 - accuracy: 0.9648 - val_loss: 0.1353 - val_accuracy: 0.9669 - lr: 1.0000e-05
Epoch 18/20
2419/2419 [==============================] - 1054s 436ms/step - loss: 0.1499 - accuracy: 0.9683 - val_loss: 0.1307 - val_accuracy: 0.9653 - lr: 1.0000e-05
Epoch 19/20
2419/2419 [==============================] - 1051s 434ms/step - loss: 0.1327 - accuracy: 0.9708 - val_loss: 0.1378 - val_accuracy: 0.9638 - lr: 1.0000e-05
Epoch 20/20
2419/2419 [==============================] - 1052s 435ms/step - loss: 0.1177 - accuracy: 0.9749 - val_loss: 0.1257 - val_accuracy: 0.9669 - lr: 1.0000e-05
```

FIGURE 5: Training Results of Developed Enhanced CNN Model for Bird Classifications in a Rice Farm with epoch=20

TABLE 1
TRAINING AND VALIDATION ACCURACIES AND LOSSES FOR THE ENHANCED CNN MODEL WITH EPOCH=20

Epoch Number	Training Accuracy	Training Loss	Validation Accuracy	Validation Loss
1/20	0.0573	5.7628	0.2731	4.0439
2/20	0.2440	4.0508	0.5829	2.6073
3/20	0.4573	2.8842	0.7657	1.5923
4/20	0.6284	2.0255	0.8484	0.9710
5/20	0.7362	1.4528	0.8899	0.6386
6/20	0.8004	1.0776	0.9139	0.4567
7/20	0.8448	0.8295	0.9242	0.3471
8/20	0.8733	0.6563	0.9387	0.2818
9/20	0.8946	0.5369	0.9459	0.2401
10/20	0.9087	0.4492	0.9531	0.1992
11/20	0.9227	0.3802	0.9562	0.1895
12/20	0.9331	0.3254	0.9554	0.1751
13/20	0.9412	0.2811	0.9688	0.1577
14/20	0.9486	0.2468	0.9684	0.1558
15/20	0.9547	0.2149	0.9642	0.1440
16/20	0.9599	0.1895	0.9646	0.1413
17/20	0.9648	0.1687	0.9669	0.1353
18/20	0.9683	0.1499	0.9653	0.1307
19/20	0.9708	0.1327	0.9638	0.1378
20/20	0.9749	0.1177	0.9669	0.1257

From the results in Table 1, the developed enhanced CNN model for bird classification in a rice farm has increased number of trainable parameters as shown in Figure 3 which after the back-propagation training with a dataset of 2419 images of sparrow birds yielded very low training losses as shown in Figures 5 and 6. Also, the validation loss was small with high validation and training accuracy of 97% as also shown in Figures 5 and 6. Bird features identification-image processing studied by [13] obtained an accuracy of 76%.

This shows that 97 out of every 100 Sparrow images will be correctly classified while 3 will be classified wrongly. The gap between the training and validation losses narrowed as the epoch increased. The training and validation losses became equal at epoch of 20. Showing that 20 is the optimal epoch. Similarly, the difference between the training and validation accuracy reduced as the epoch increased and became zero at epoch of 19. This mean that best accuracy will be obtained a training Epoch of 19.

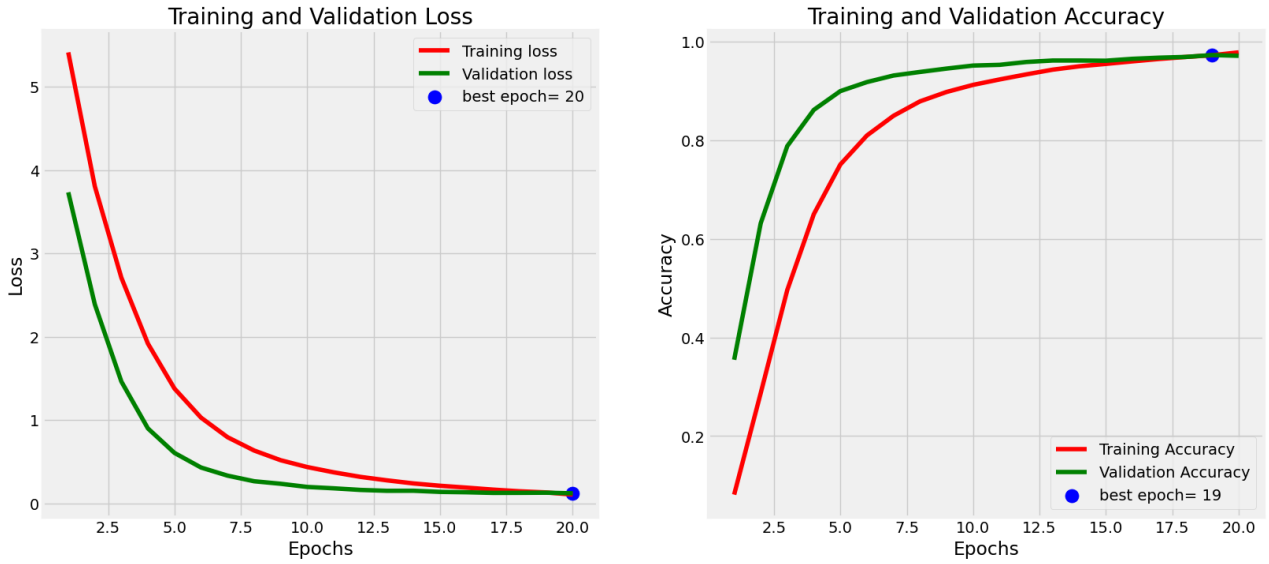


FIGURE 6: Training and Validation Accuracies and Losses of the Developed Enhanced CNN Model

3.2 Beneficial bird Classification in Google Colab Platform

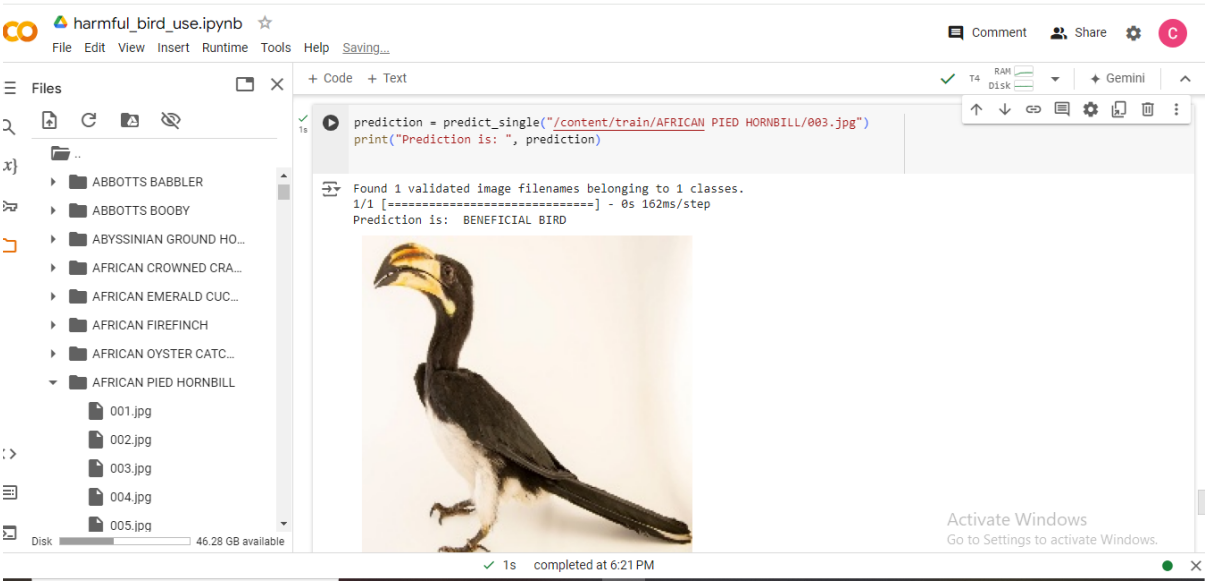


FIGURE 7: Result of Beneficial Bird Classification in Google Colab

Figure 7 shows the result of the developed CNN model that classified a bird image fed into it as beneficial. The image of the bird was captured from a bird database called bird.cvs and the path name of the bird was copied and pasted into the prediction path name of google colab. The developed enhanced CNN model hosted in kaggle was first downloaded from kaggle to google colab and then unzipped and moved to the google colab prediction environment for bird classification.

3.3 Result of Harmful bird Classification in Google Colab Platform

Figure 8 shows the result of the developed enhanced CNN model that classified a bird image fed into it as harmful. The image of the bird was one of the captured images from the rice farms used in this research and the path name of the bird was copied and pasted into the prediction path name of google colab. The developed enhanced CNN model hosted in kaggle was first downloaded from kaggle to google colab and then unzipped and moved to the google colab prediction environment for bird classification. Once the model classified the bird as sparrow, the developed algorithm in the raspberry pi 2 or computer activates the speakers to produce the recorded sound of the predator (squirrel) which plays on the prediction window as shown in Figure 8.

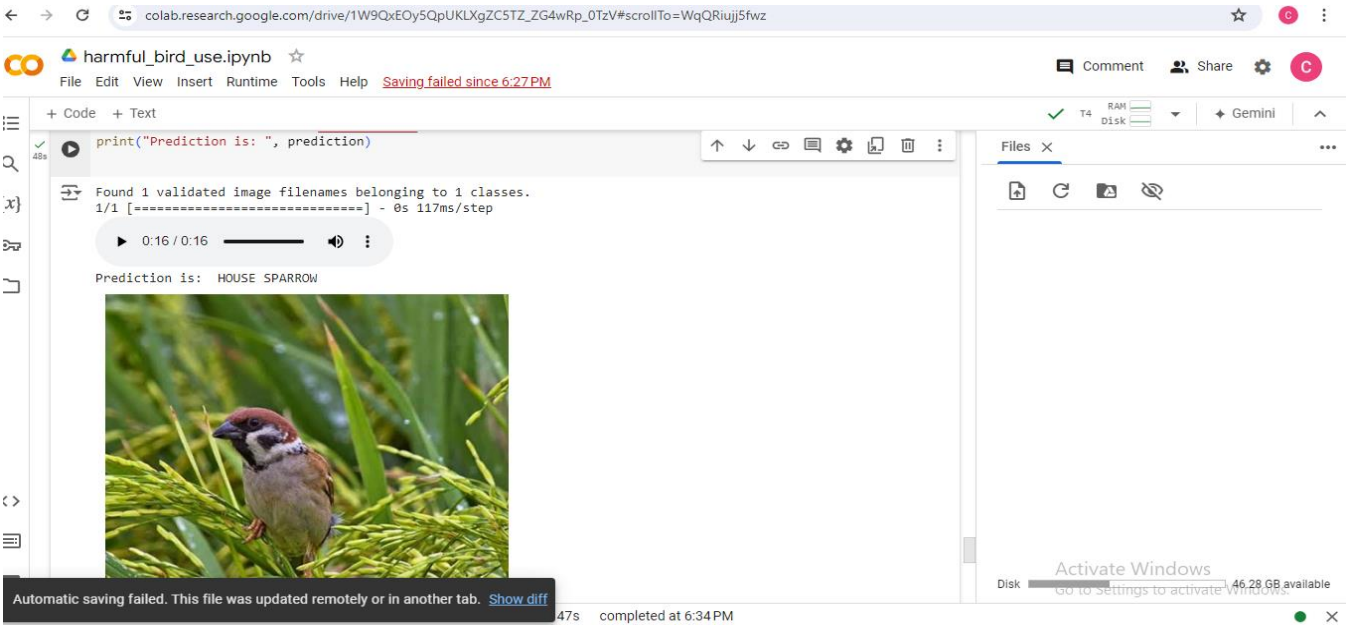


FIGURE 8: Result of Harmful bird Classification in Google Colab Platform

3.4 Results of Model Evaluation

Figure 9 shows the result of predictions of the model with True Positives, True Negatives, False Negatives and False Positives for 700 images predictions. Using the predictions shown in Figure 7, the parameters were obtained as follows:

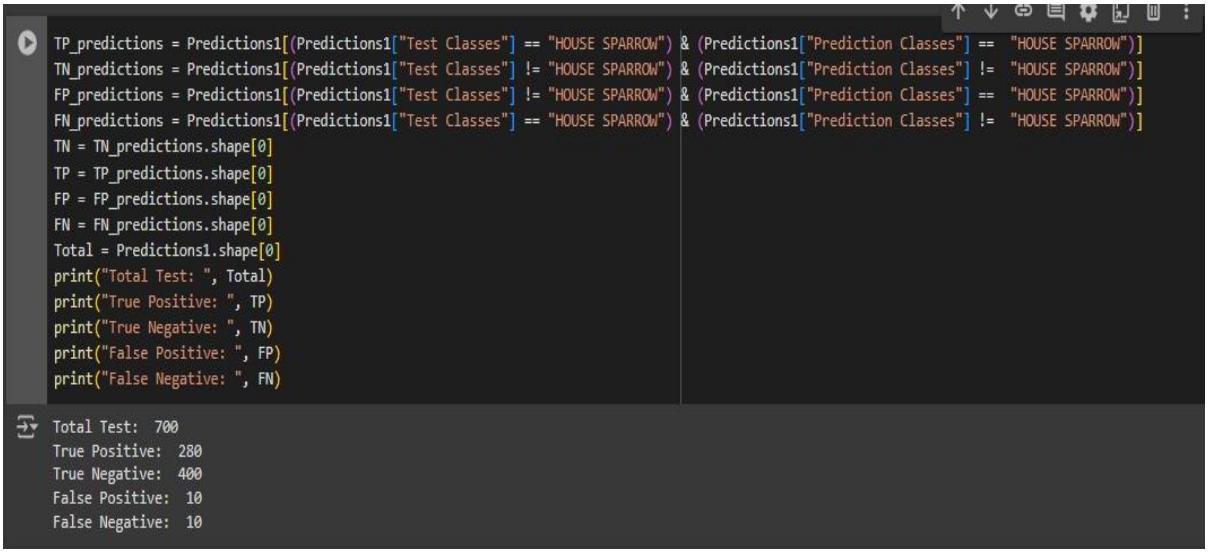
$$Accuracy = \frac{280+400}{280+400+10+10} = 97.2\% \quad (1)$$

$$Precision = \frac{280}{280+10} = 96.5\% \quad (2)$$

$$\text{Recall} = \frac{280}{280+10} = 0.965 \quad (3)$$

$$F1\ Score = \frac{2\times0.965\times0.965}{0.965+0.965} = 0.965 \quad (4)$$

Thus 680 images of the 700 brought for recognition were correctly recognized. 280 sparrow images were truly recognized by the while 10 sparrow images were wrongly recognized as "not-sparrow". 400 other birds' images were correctly recognized as "not-sparrow", while 10 other birds images were wrongly seen as Sparrow. This means that for every 100 Sparrows that approached the farm, the system will rightly activate the predator sound for approximately 88 and wrongly refrain from making a scaring sound for 12 Sparrows. Similarly if 100 other birds approached the farm, the system will rightly refrain from making a scaring sound for approximately 97 birds and wrongly activate the predator sound for 2.5 (approximately 3) of the birds. The system precision was 96.5%.



```
TP_predictions = Predictions1[(Predictions1["Test Classes"] == "HOUSE SPARROW") & (Predictions1["Prediction Classes"] ==  "HOUSE SPARROW")]
TN_predictions = Predictions1[(Predictions1["Test Classes"] != "HOUSE SPARROW") & (Predictions1["Prediction Classes"] !=  "HOUSE SPARROW")]
FP_predictions = Predictions1[(Predictions1["Test Classes"] != "HOUSE SPARROW") & (Predictions1["Prediction Classes"] ==  "HOUSE SPARROW")]
FN_predictions = Predictions1[(Predictions1["Test Classes"] == "HOUSE SPARROW") & (Predictions1["Prediction Classes"] !=  "HOUSE SPARROW")]
TN = TN_predictions.shape[0]
TP = TP_predictions.shape[0]
FP = FP_predictions.shape[0]
FN = FN_predictions.shape[0]
Total = Predictions1.shape[0]
print("Total Test: ", Total)
print("True Positive: ", TP)
print("True Negative: ", TN)
print("False Positive: ", FP)
print("False Negative: ", FN)
```

```
Total Test:  700
True Positive:  280
True Negative:  400
False Positive:  10
False Negative:  10
```

FIGURE 9: Results of Evaluation of the Model

IV. CONCLUSION

The developed Sparrow deterrent system used the bird classification into harmful sparrow and beneficial birds by the Convolutional neural network (CNN) model to scare away pest-sparrow bird using predator sound. When the model was used for predictions as shown in Figure 9, it was able to give high accuracy (97.2%), precision (96.5%), recall (0.965) and F1 score (0.965) of the model .Also in a Google Colab platform, the developed model was able to classify birds into harmful sparrow and beneficial (insectivorous) birds. It allowed the beneficial bird in 97% of their visits. Hence, it allowed the beneficial bird to continue its biological pest control without disturbances. However, when the model classification returned harmful Sparrow as shown in Figure 9, it generated the sound of Squirrel which is the predator 97% of the times to scare them away. This was better than the 76% accuracy birds' classification obtained by a previous researcher [13].

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Design and Fabrication of Melon Shelling and Separating Machine

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Abstract— *Although there are several designs on melon shelling machines, it is observed that these available designs in the market are relatively more sophisticated and expensive hence they are not affordable to majority of local farmers. The aim of this work is to design and fabricate cheap and affordable melon shelling and separating machine which can effectively shell all the species of melon through electric powered operation, with little or no technical skill required for its operation and at a cheap affordable price using local available materials. The machine was evaluated to determine the percentage number of shelled and unshelled melon seeds, shelled but broken seeds and the partially shelled melon seeds at 7% and 10% wb and concave speeds of 750, 950 and 1200 rpm. At concave speeds of 750, 950 and 1200 rpm, and moisture content (MC) of 7% wb, the calculated shelling capacity of the Sheller were 65, 128 and 148kg/h respectively. The cleaning capacity was 52kg/h, 85kg/h and 85kg/h respectively. When the MC of the melon seeds was increased to 10% wb by sprinkling the seeds with water and allowing it to dry by natural air, the shelling capacity became 53kg/h, 88kg/h and 145kg/h for the concave speeds of 750, 950 and 1200 rpm respectively. At 10% MC the cleaning capacity reduced from 53kg/h to 39kg/h at the speed of 750rpm and from 85kg/h to 66kg/h at the speed of 950rpm. However, at 1200rpm the cleaning capacity increased from 85kg/h to 109kg/h. The fraction of fully shelled melon seeds at mc of 7% wb using the concave speeds of 750, 950 and 1200rpm were 54%, 45% and 45%, while percentage of broken seeds were 85, 95 and 97%, and the number of partially shelled seeds were 42%, 54% and 54%; the percentage number of unshelled seeds were 3.9%, 1% and 0.3%. Moreover, , at the MC 10% wb using the same concave speeds of 750, 950 and 1200rpm the percentage number of broken seeds reduced to 0.8%, 2.3% and 8.9%. Based on this result, the machine is found to be very effective in peeling melon seeds at 10% M.C and at a concave speed of 1200rpm since the ratio of the number of unshelled melon seeds to the quantity in each sample is very negligible.*

Keywords— shelling and separating machine, fully shelled seeds, shelled broken seeds, partially shelled seeds, moisture content, cleaning capacity.

I. INTRODUCTION

1.1 Melon cultivation:

Melon (*Citrullus Vulgans*), is a common vegetable crop which is widely cultivated in Nigeria (Fadamoro, 1999; Oluwale and Adedeji, 2012). Oni, (2005) classified melon as a legume crop because it has the capacity of preventing or controlling the growth of weeds on the farm and can add Nitrogen to the soil through the process of Nitrogen fixation. Melon can normally be planted twice in a year - during the rainy season and during the dry season and that it is most common in Northern parts of Nigeria particularly Kano, Kaduna and Jos. After harvesting melon, the seeds are carefully removed from the pod and washed very well with water. Solar energy is then used in the conventional way to dry them (Carter, 2002, Ogwo and Oranu, 2006).

The processing of melon is imperative to further diversify its use. This includes shelling, washing, coring, drying, fermenting, drying and extracting of oil. Shelling involves removing the outermost part (husk) from the melon kernel. Here, the seed is separated from the spiny husk. This operation can be carried out in the field or at the storage environment (Nwakire *et al.* 2011). This research therefore seeks to offer assistance to the teaming population of local melon farmers or traders and medium scale industries involved in the melon business in their quest for a convenient, available and easy method of shelling their melon which in most cases is still being done manually due to either very high cost or unavailability of shelling machines

1.2 Uses of Melon:

Melon (*Colocynthiscitrullus L.*) is an extensively cultivated and consumed oil seed crop in Nigeria and West Africa (Bankole *et al*. (2005). Okokon *et al*. (2010), reported that melon is the fourth most important crop in the world in terms of production after orange, banana and grapes. These seeds are vastly nutritious, furnishing the human diet with good quality proteins (Ogbonna and Obi, 2007). It contains about 41.51% essential amino acids (Sabo *et al.* 2015) and other essential nutrients (Nwakire *et al.* 2011; Shittu *et al*. 2002). Melon seeds are of great economic importance in Nigeria. They are used for soup preparation (Oke, 1996; Obienwe, 2002). Thus, melon seeds are the major condiments in the popular "*egusi"* soup in every part of Southern Nigeria. In other words, Melon seeds can be used for the following purposes: soup thickeners, for preparation of vegetable oil, livestock feed, preparation of melon cake and food for man (Amudu, 1981; Babale, 1988; Oni, 2005).

Melon seed is also a good source of minerals, vitamins, oil and energy in the form of carbohydrates (Olaniyi, 2008). The seed contains 0.6 g proteins, 4.6 g carbohydrates, 33 mg vitamin C, 0.6 g crude fiber, 230 mg K, 16 mg P, 17 g Ca per 100 g edible seeds and unsaturated fatty acids (Mohammed, 1989).

According to Bankole *et al.* (2005), it is grown mainly for the use of its shelled kernel. This can be sprinkle into a soup or stew and can also be ground into a thick paste. It can also be transformed into products such as "ogiri," baby "robo cake" and livestock feed, whereas its oil is used in the production of soap and local pomade (Oyawole and Adeniyi, 2009; Shittu and Ndrika 2012).

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1.3 Shelling of melon seeds:

One of the greatest problems affecting technology development and indeed agricultural development in Nigeria is the absence of cheap processing equipment (Shittu and Ndrika, 2012). The available agricultural processing machines and equipment in the market are very expensive and cannot be conveniently afforded by many local farmers in the country. Secondly, the designs of the available ones are sophisticated and cannot easily be operated by the local farmers. Also, lacks of their spare parts render them un-sustainable. All these add to make melon cultivation and processing difficult and thus, limit its massive production and therefore scarce in the market..

Although there are several designs on melon shelling machines, it is observed that these available designs in the market are relatively more sophisticated and expensive hence they are not affordable to majority of local farmers. The old traditional methods of shelling melon are still in use in rural areas which involve hurling the melon shell with bare hands. This method is too slow, time consuming, drudgery, and in-efficient.

Shelling of melon as a unit operation is an important step towards the processing of melon to its finished products. Most farmers, who cultivate this crop in Nigeria and West Africa, encounter several processing challenges of its shelling as it requires relatively high expenditure of human energy that is a major concern (Odigboh, 1979; Kafi, 1980; Shittu and Ndrika, 2012). The inability to effectively shell melon in order to meet the requisite quantity necessary for industrial utilization has been a hindrance to its use for large-scale production of various commodities (Nwachukwu, 2001; Adekunle *et al.* 2009). Melon is conventional method of shelling melon is manual which is inefficient, tedious and time consuming, thus limiting the availability of the product in the market (Pradhan *et al*. 2010; James *et al*. 2011). Furthermore, this obsolete method results in bruising and injury to the human fingers, coupled with low output rates (Nkakini *et al*. 2007). Thus, the quest for a satisfactory, cheap and effective means such as mechanized shelling technique is of importance, for small- and medium-scale farmers in Nigeria. Different forms and types of melon sheller exist, according to their source of power, and can thus be classified as electrically powered or fuel-driven melon sheller (Adekunle *et al*. 2009; James et al. 2011).

1.4 Material Separation

According to Oja (1991), a mixture is a substance which contains two or more substances physically combined together. Mixtures of substances can be separated by physical means. There are varieties of physical methods used to separate variety of mixtures. The particular method employed for any given mixture depends upon the nature of the constituents such as: the relative sizes and shape of the constituents, the weight, boiling point, melting point and density of the constituents..

Henderson and Perry (1981) identified four common methods used for separating a mixture of grain seeds from their shells or husks. These are: handpicking, sieving, inclined surface and blowing. By the hand picking method, the components that are bigger in size are first handpicked leaving the ones that are smaller in size. For example, a mixture of maize and sand, rice and beans, palm kernels and its shells, beans and its shells, etc. This method can also be used for separating melon seeds from its shells after peeling. This sieving method involve pouring the mixture on a sieve and shaking it so that the constituent that is smaller in size will pass through the sieve leaving the other constituent on top of the sieve. Sieving can be used to separate a mixture of rice and sand, beans and rice, oil palm fruit and its husks, etc.

The inclined table method, according to Henderson and Perry (1981), involves the pouring of the mixture on an inclined surface so that the seeds will roll down leaving the husks, shells or debris on the upper part of the inclined surface. This method is mostly used for separating seeds that are round or oval in shape from their shells. For example, it is widely used for separating palm kernels seeds from its shells and oil palm fruits from its husks or debris. The last method, blowing involves blowing the mixture either by mouth or through a mechanical or electrical method so that the lighter constituent in the mixture will be blown off leaving the other constituent behind. This method is very good in separating melon seeds from its shells as well as for separating rice from its husks.

II. MATERIALS AND METHODS

2.1 Materials:

The materials required for the project include: mild steel sheets, 1 inch angled iron bars, 2 inches pipes, welding electrodes, soft solders, soldering flux, emery cloth, assorted bolts, nuts and screws, varnish, paint, 1.5 gauge coil wire, belts and flexible wires and electric motor.

2.2 Tools:

The following hand tools were used in the design and construction of the melon peeling and separating machine: steel rule, measuring tape, scriber, center punch, hacksaw, bench shears, cold chisels, assorted files, taps and dies, a pair of pliers, screw drivers, bench vice, hammer and spanners. The machine tools used included welding machine and their accessories, drilling machine and spraying machine.

2.3 Methods:

Some physical, mechanical and gravimetric properties of melon seeds were studied and employed in the design and fabrication of the machine. Some physical and gravimetric properties of melon seeds at 6.25% (d.b) such as the mean values of angle of repose, bulk density, porosity and seed dimension of melon seeds influenced the design configuration of the hopper, shelling mechanism and the delivery chute. The mass, true and bulk densities of the seeds were employed in the shaft design and power requirement determination. The moisture content of melon seed samples were determined by the oven drying method.

2.4 Physical, Gravimetric and Frictional Properties of Melon Seeds:

Some physical, gravimetric and frictional properties of melon seeds that are pertinent to the mechanical processing determined by Davies (2010) are considered by the design and the development of the machine. The properties of the melon variety *Citrullusedulis* that was used are presented in Tables 1 and 2.

TABLE 1
SOME PHYSICAL PROPERTIES OF MELON (*CITRULLUSEDULIS*) SEEDS AT 6.25% (D.B.)

S/N	Properties	No of samples	Mean Values
1.	Length (mm)	100	12.81
2.	Width (mm)	100	7.02
3.	Thickness (mm)	100	2.22
4.	One thousand unit mass (g)	50	94.0
5.	Arithmetic mean diameter (mm)	100	7.36
6.	Geometric mean diameter	100	134.64
7.	Sphericity	100	0.47
8.	Surface area (mm)	50	134.64
9.	Volume (mm^3)	100	154.83

TABLE 2
SOME GRAVIMETRIC AND FRICTIONAL PROPERTIES OF MELON SEEDS (*CITRULLUSEDULIS*) AT 6.25% (D.B.)

S/N	Properties	Mean Value
1.	Bulk density (kg/m^3)	405
2.	True density (kg/m^3)	816.83
3.	Porosity %	53.7
4.	Angle of repose (degree)	36
5.	Coefficient of static friction on Glass	0.35
6.	Plywood	0.51
7.	Galvanized metal	0.43
8.	Concrete	0.56

Source: Davies (2010).

Parameters such as, angle of repose, bulk density, porosity, seed dimensions and seed shape influence the sizing and the shape of feed hopper, rotor and delivery chute. Seed mass, true and bulk densities are parameters that dictate the speed of prime mover that provides adequate seed momentum in the shelling unit.

2.5 Design Procedure:

The sequential procedure for construction design and construction of the Mellon Sheller is presented in the block diagram as shown in Fig. 1 below.

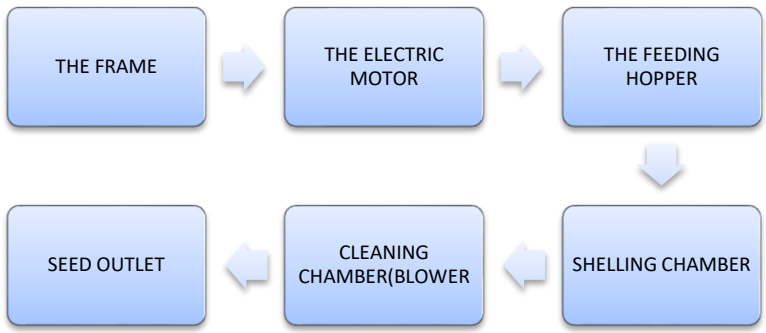


FIGURE 1: Sequential constructional procedure of the Melon Sheller.

2.6 The components of the Melon Sheller:

The major components of the Melon Sheller are: the frame, hopper, shelling and the cleaning chamber.

2.6.1 The frame:

The frame is the support on which the whole unit rest. It bears the load and vibration of the machine. It is a rectangular block that is made of mild steel. The various pieces are joined together by welding to ensure that it is strong, studded and does not shake nor wobble. Four holes are drilled on the mild steel plate for bolts which holds the electric motor firmly in position.

2.6.2 The hopper:

The hopper is made up of four welded metal sheets slanting towards an opening to form a trapezium with two openings. The larger upper opening is for introducing the melon seeds into the sheller while the smaller lower opening connects and opens directly into the shelling unit through a centralized hole. It is meant to receive the melon seeds before they are eventually moved into the shelling chamber. The hopper is made up of four welded mild steel metal sheet of thickness 2mm slanting towards the sheller. The mild steel metal sheet was marked out with the aid of set square, steel rule and scriber. An allowance of 10mm was given on all edges of the sheet to cater for hemming. Cutting was done with a shearing machine, chisel and hammer. The cut out sheet was later folded and thereafter welded using manual arc welding machine.

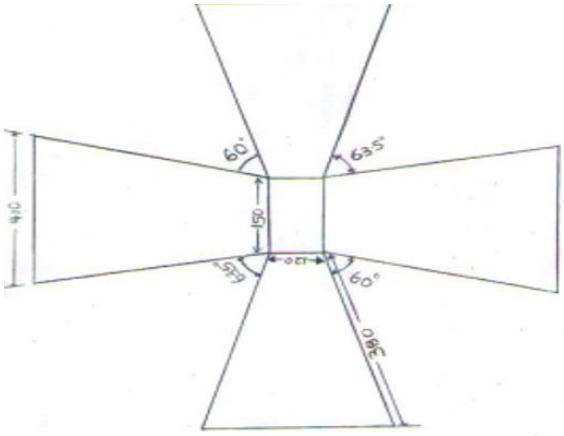


FIGURE 2: Development of the Hopper

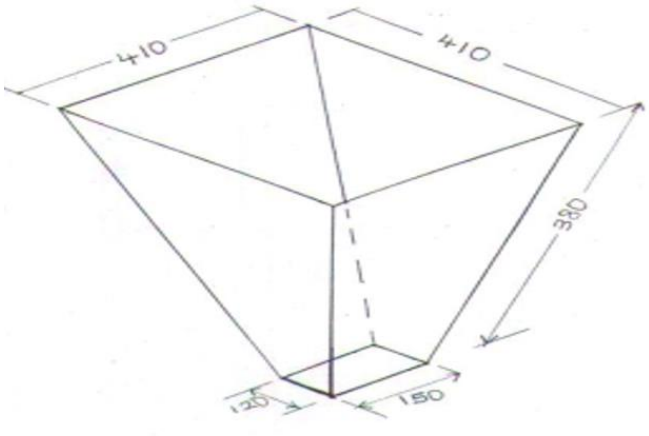


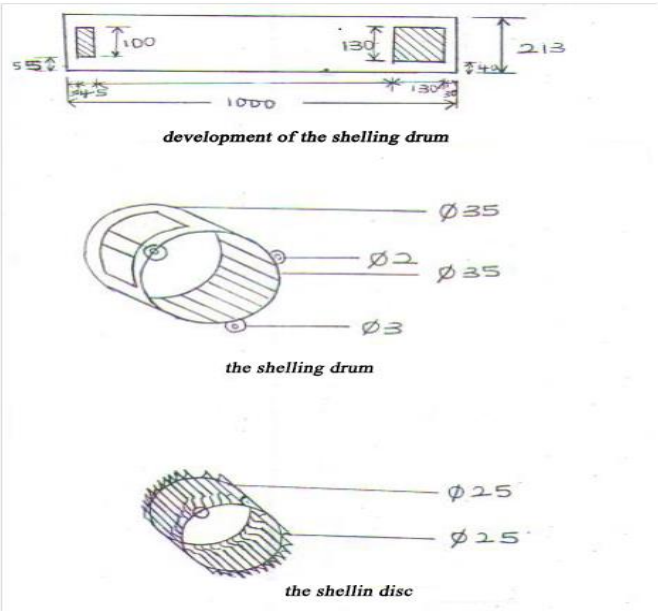
FIGURE 3: The Hopper

2.6.3 The Shelling Chamber:

The shelling chamber consists of concave and cylinder (convex), shelling drum powered by an electric motor. The concave is made from mild steel and the inner part of the drum is lined with tinny metal rods, while the cylinder is lined with flat metal blades. The cleaning chamber is made of galvanized mild steel plate folded to form a pipe. A regulated fan is installed at one end of the pipe to supply air that will separate the chaff from the cotyledon after shelling. The sheller employs the principle of energy absorption by the melon seeds, as a result of collision between the seeds and the stationary wall of the drum and this causes the cracking and removal of the husk from the seed.

Unshelled melon seeds are fed into the hopper of the sheller when the sheller attains a speed of about 950rpm after which the seed control device is opened to allow the seeds to fall directly into the shelling chamber. The melon seeds that dropped into the shelling chamber from the hopper move anticlockwise in the space between the vanned rotating disc and the rough stationary drum. Since the average thickness of melon seed is 2.5mm, the seed will tend to move in a single row. The rotation of the impeller causes the removal of the coat from the cotyledon of the seeds as they rub against the rough surface of the fixed wall of the drum.

The chaff and the cotyledon will fall by gravity into the cleaning chamber of the sheller. A regulated fan installed in the chamber blows off the chaff and the cotyledons will fall by gravity and are collected at the seed discharge unit of the sheller. The air velocity in the cleaning chamber must be less than the terminal velocity of the melon seed.



2.6.4 Cleaning chamber:

The cleaning unit is meant to facilitate the separation of the shelled melon seeds from the chaff. The cleaning unit consists of mild steel folded and welded to form a hollow cylinder that lye horizontally. A regulated fan (relative to the speed of the shelling unit) is installed at one end of the cylinder to supply air for separation of the chaff from the cotyledon after shelling. An outlet chute is created at the base of the cylinder which serves as the outlet for collection of the cleaned melon seeds.

2.6.5 Electric Motor:

The electric motor is meant to transmit power or rotational motion to the shelling disc through its protruding shaft with the aid of a key that fastened them together. The power rating of the electric motor is 2hp.

2.6.6 Power Requirement:

The total power required is calculated using the equation as specified by Odigbo, (1979) and as cited by Oluwole and Adedeji, (2012).

$$PT = P_{inner}\ drum + P_{shaft} + P_{shelling} \quad (1)$$

Where:

PT = total power required.

$P_{shelling}$ is negligible since seeds are not resident in sheller but flow through in pieces.

$$\text{Therefore, } PT = P_{inner\ drum} + P_{shaft} \quad (2)$$

But the shaft and inner drum were welded together, so that

$PT = P_{inner\ drum\ with\ shaft}$

$P_{inner\ drum\ with\ shaft} = T_{inner\ drum\ with\ shaft}$ x $V_{inner\ drum\ with\ shaft}$

$V_{inner\ drum\ with\ shaft} = \frac{2\pi N}{60} m/s$

$T_{inner\ drum\ with\ shaft}$ is the torque (Nm)

N = is the number of revolution per minute of the inner drum with shaft = 350 rpm $T_{inner\ drum\ with\ shaft}$ = mass x acceleration due to gravity x radial distance

But the Mass of the inner drum with shaft = 5.6kg,

Acceleration due to gravity = 10 m/s^2

Radial distance = 0.127m

$T_{inner\ drum\ with\ shaft}$ = 5.6 x 10 x 0.127 = 7.112Nm

$P_{inner\ drum\ with\ shaft} = 7.112X\frac{2 \text{ x } 3.14 \text{ x } 350}{60 \text{ x } 1000}$ = 0.2607KW = 0.349Hp

Using the factor of safety of 2, power required is 0.70Hp; therefore a motor of 1Hp is chosen to power the inner drum, shaft for shelling the seeds. However, in practice 2Hp was used instead.

2.6.7 Terminal velocity:

Pneumatic separation of grains involves the separation of foreign materials from the grain with the aid of air stream. The air is made to pass through the disposed material to affect their separation. The design of fan for effective grain cleaning takes advantage of the variation in the aerodynamic properties of the grain (Ogunlowo and Ademosun, 1990). The terminal velocity of the shelled seeds and chaff will be determined as follows:

$$Mg = ½\ pVt^2C_dA \quad (3)$$

Where:

M = mass of the object (kg); g =gravitational acceleration (m/s^2); C_d = drag coefficient; p = air density (kg/m^3); A = projected area (m^2); V_t = terminal velocity (m/s).

III. RESULTS AND DISCUSSIONS

3.1 Assembling of the Final Product:

Assembling of the final product was done after the different component parts of the melon shelling and separating machine was constructed using the sequential constructional procedure. Two types of joints were used during the process. These were permanent joints and temporary joints. Permanent joints were used in joining the feeding hopper to the top of the peeling chamber through the process of welding. The separating port was also welded to the main frame. Bolts and nuts were used to fasten the three main components of the machine namely the electric motor, peeling chamber and blower unit to the main frame.

The need to use bolts and nuts for these components was to produce temporary joints which could facilitate easy detachment of any of these component parts during maintenance operations. Lastly, the power cord was connected to the electric motor and its free end was fitted with a three-prong plug. After the assembling, the machine was cleaned with emery cloth and wire brush to remove dirt and dust. Thereafter, paint was applied to it to give it a smooth finish and a beautiful appearance. The completed product is as shown below in Fig. 4.

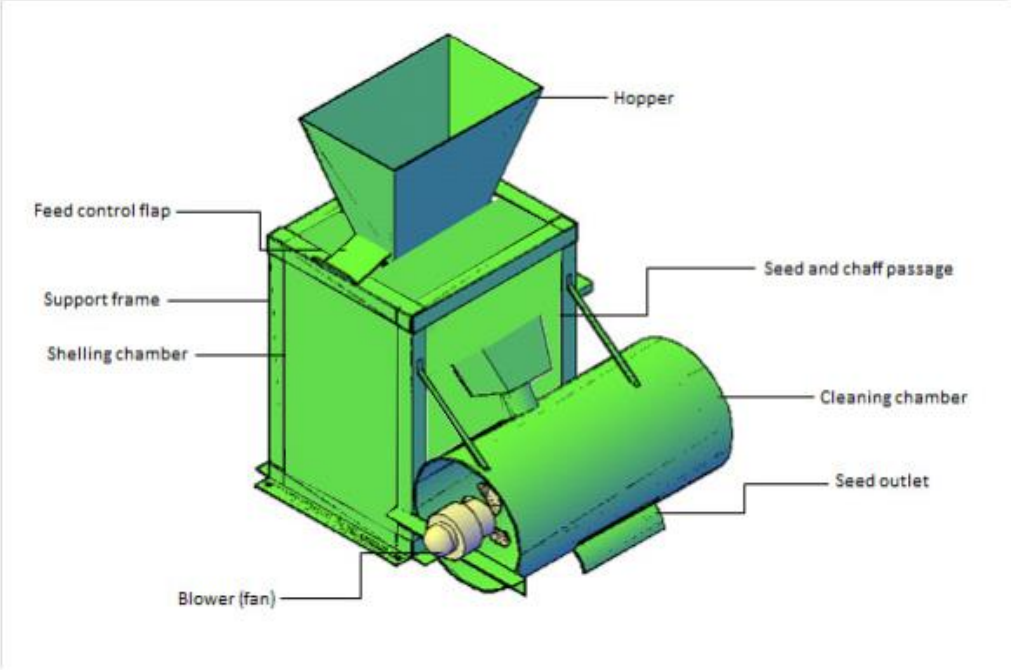


FIGURE 4: Orthographic view of the machine

3.2 Operation of the Melon Shelling and Separating Machine:

The power cord of the machine should first be plugged into the electric mains after which the machine is switched on and left to operate for few minutes to enable it attain its operational speed. The melon seed to be peeled should first be sprinkled with water and allowed for some time to dry up so as to make the seed coast softer which facilitates easy peeling. About 5 kg of melon seeds were fed into the shelling unit through the hopper continuously but gradually. The seeds passed through the lower opening of the hopper onto the vanes into the shelling unit.

In the shelling unit, the melon seeds were thrown against the wall of the shelling drum and the rotating vanes. Through impact of the shelling vanes, walls of the shelling drum, and collision of the seeds with each other, the shells were weakened and subsequently broken. After the shelling process, both mixture of the seeds and chaff fell through a chute, leading to the cleaning unit. In the cleaning unit, a fixed regulated fan separates the shelled seeds from the chaff by air current. The denser shelled seeds fell through the discharge outlet, while the chaff is blown out through a chute opposite the fan.

3.3 Performance Evaluation of the Sheller:

The performance evaluation of the melon sheller was carried out with a 2-horsepower electric motor, using melon seeds of various quantities. The unshelled melon seeds at moisture content of 7% were first shelled at three different speeds of 750 rpm, 950 rpm and 1200 rpm of the cylinder. The second sample of melon seeds was sprinkled with water and partially dried with

natural air for 10 minutes. This made the skin coat to become slightly softened and the cotyledon was easier to detach from the shell, thus making shelling more efficient (Olusegun *et al.,* 2008). The moisture content of the melon seeds that were sprinkled with water and dried for 10 minutes was found to be 10%. This was used for the second test.

The number of seed shelled and unbroken, shelled but broken, partially shelled and unbroken, partially shelled but broken and the number of seeds unshelled were counted separately after shelling operation. The quantity of chaff blown by the fan was also collected and weighed at the different speeds of 750, 950 and 1200 of the sheller.

The number of seeds in sample is represented as N_0, number of seeds shelled and unbroken as N_1, number of seeds shelled but broken as N_2, number of seeds partially shelled and unbroken as N_3, number of seeds partially shelled but broken as $N_4$and number of seeds unshelled as N_5 (Odigboh, 1978). The shelling capacity of the machine was calculated as the weight of the sample shelled per unit time.

$$\text{Shelling capacity} = {}^{W}/_{t_1} \text{ kg/h} \quad (1)$$

The cleaning capacity is the quantity of seeds cleaned

$$\text{Per unit time} = {}^{W}/_{t_2} \text{ kg/h} \quad (2)$$

$$\text{Shelling efficiency } E_S\ (\%) = {}^{(100X_a)}/_{(X_a + X_c)} \quad (3)$$

Cleaning efficiency

$$E_C(\%) = {}^{(100X_d)}/_{(X\mathrm{d} + X_b)} \quad (4)$$

Where;

W= weight of the sample shelled

T= time

X_a= weight of seeds received at the seed outlet

X_b= weight of chaff received at the seed outlet

X_c= weight of grain received at chaff outlet

X_d= weight of seeds received at chaff outlet

Source: Nigerian Industrial Standard (1997)

$$\text{The fraction of melon seeds completely shelled} = \frac{N_1+N_2}{N_0} \times 100 \quad (5)$$

$$\text{Fraction of seeds partially shelled} = \frac{N_3+N_4}{N_0} \times 100 \quad (6)$$

$$\text{According to (Odigboh, 1978), fraction of seeds unshelled} = \frac{N_5}{N_0} \times 100 \quad (7)$$

3.4 Experimental Design and Statistical Analysis:

The experimental design for the statistical analysis (Obi, 1995) follows a 2-treatment effect (moisture content and shaft speed) in a split-plot factorial design with RCBD (Randomized Complete Block Design) involving a 2-way classification. The experimental unit comprises 2 factors (two varieties) in each of the three levels of the shaft speed giving 6- treatment combinations for the three different experiments as follows

- Shaft speed (750 rpm) versus moisture content
- Shaft speed (950 rpm) versus moisture content
- Shaft speed (1200 rpm) versus moisture content

The moisture content has two levels while the shaft speed has three levels. The moisture content separately forms the levels for factor A while the shaft speed in any of the three combinations forms the levels of factor B. On the whole the analysis studied three different operations of shelling capacity, cleaning capacity and percentage of shelling at $P \leq 0.05$ and $P \leq 0.01$

IV. RESULTS AND DISCUSSIONS

4.1 Results:

Table 3 shows the summary of the measured physical properties of Melon seeds (Bara). The average performance data of the sheller at moisture content of 7% and 10% and cylinder speeds of 750 rpm, 950 rpm and 1200rpm respectively are shown in Table 4, while the performance indices of the sheller are given in Table 5. The calculated power requirement and terminal were 2hp and 6.4m/s respectively

TABLE 3
SUMMARY OF MEASURED PHYSICAL PROPERTIES OF MELON SEEDS (BARA)

Parameters	Unshelled Seeds	Shelled +Cotyledon	Shelled Seed	Chaff
7% M.C. Angle of repose (θ) (deg)	35.7	40.5	43.3	-
Coefficient of friction (θ) (deg)	0.72	0.85	0.95	-
10 % M.C. angle of repose (θ) (deg)	36	45.81	44	-
Coefficient of friction (θ) (deg)	0.73	1.03	0.97	-
Weight of one seed (g)	0.124	0.124	0.022	0.0221
Length of seed (mm)	12.4	-	11.0	-
Width of seed (mm)	7.6	-	6.5	-
Thickness of seed (mm)	2.5	-	1.8	-

TABLE 4
THE AVERAGE PERFORMANCE INDICES OF THE MELON SHELLING MACHINE AT TWO DIFFERENT MOISTURE CONTENTS OF 7% AND 10% AT 3 DIFFERENT SPEEDS OF 750 RPM, 950 RPM AND 1200 RPM.

Parameters	7%MC			10%MC		
	750	950	1200	750	950	1200
Weight of unshelled seed (g)	7.7	7.1	118.4	11.4	73	120.9
Time to complete shelling t_1 (s)	4	2	3	11	3	3
Time to complete shelling t_2 (s)	5	3	5	11	4	4
No of seeds in sample (N_0)	578.5	575	955	955	575	955
No. of seeds shelled and unbroken (N_1)	36.5	17	18	701	537	836
No of seeds shelled but broken (N_2)	277	244	228	5	7	58
No of seeds partly shelled and unbroken(N_3)	29	6	2	113	22	26
No of seeds partly shelled but broken (N_4)	217	305	575	3	7	27
No of seeds unshelled (N_5)	23	6	3	128	4	8

TABLE 5
PERFORMANCE INDICES OF THE SHELLING

Parameters	7%MC			10%MC		
	750	950	1200	750	950	1200
Shelling Capacity (kg/h)	65	128	148	53	88	145
Fully shelled (%)	54	45	45	74	85	93
Partly shelled (%)	42	54	54	12	5	6
Unshelled (%)	4	1	1	13	1	1
Broken (%)	85	95	98	1	2	9
Cleaning Capacity (kg/h)	52	85	85	39	66	109
Efficiency of the Sheller (%)	75	8o	82	80	85	90

4.2 Discussions:

The parameters studied were the percentage number of shelled and unshelled melon seeds, shelled but broken seeds and the partially shelled melon seeds at 7% and 10% wb respectively; and at the concave speeds of 750 rpm, 950 rpm and 1200 rpm. At concave speeds of 750 rpm, 950 rpm and 1200 rpm respectively at moisture content of 7% wb, the calculated shelling capacity of the sheller were 65kg/h, 128kg/h and 148kg/h respectively. The cleaning capacity was 52kg/h, 85kg/h and 85kg/h respectively. When the moisture content of the melon seeds was increased to 10% wb by sprinkling the seeds with water and allowing it to dry by natural air, the shelling capacity became 53kg/h, 88kg/h and 145kg/h for the concave speeds of 750 rpm, 950 rpm and 1200 rpm respectively as shown in Table 5.

At the moisture content of 10%, the cleaning capacity was seen to have reduced from 53kg/h to 39kg/h at the speed of 750rpm and from 85kg/h to 66 kg/h at the speed of 950 rpm. However, at 1200rpm the cleaning capacity increased from 85kg/h to 109kg/h as showed in Table 5.

The fraction of melon seeds fully shelled by the sheller when the moisture content of the melon seeds remained at 7% wb using the concave speeds of 750 rpm, 950 rpm and 1200rpm respectively were 54%, 45% and 45%. The percentage of seeds broken were 85%, 95% and 97%, the number of partially shelled seeds were 42%, 54% and 54%. The percentage number of melon seeds that were unshelled was 3.9%, 1% and 0.c%. The 97% breakage of the melon seeds was too high for the sheller to operate at those speeds when the melon seeds moisture content was 7% wb. Although all the melon seeds fed into the sheller at the moisture content of 7% were shelled, however, there was high mechanical damage of the seeds which will lead to deterioration of the seeds as was also observed by Shittu *et al.* (2002).

When the moisture content of the melon seeds was raised to 10% wb using the same concave speeds of 750 rpm, 950 rpm and 1200rpm the percentage number of broken seeds reduced to 0.8%, 2.3% and 8.9%.

Based on these results, was concluded that the machine is very effective in peeling melon seeds at 10% M.C and at a concave speed of 1200rpm since the ratio of the number of unpeeled seeds to the quantity in each sample with reduced damage to the seeds very negligible.

TABLE 6
BILL OF ENGINEERING MEASUREMENT AND EVALUATION

Items	Quantity	Total (₦)
2 hp Electric motor	1	30,000
Metal sheet	(900mm x 1200mm x 3.5mm)	10,000
Gauge 12 electrode	1 packet	1,500
Body filler	4 liters	4,000
Steel rode Ø30mm	6000m	3,000
Contingency allowance		15,000
Total		**63,500**

V. CONCLUSION

5.1 Summary of the Method used in the Design and Construction:

The final design of the melon shelling and separating machine was designed and fabricated after careful observation of problems faced by local farmers. A sequential constructional procedure was adopted and the construction of the machine was executed step by step as follows:

1. The main frame was first constructed using angled iron. The various pieces were joined and welded together.
2. The electric motor was attached.
3. The shelling chamber was constructed with mild steel sheets. This was followed by the construction of the shelling rotor which carries the shelling blades.
4. The feeding hopper was made by welding four pieces of mild steel sheets together to form a rectangular-shaped funnel.

5. The blower unit was fabricated by enclosing a small blower in a cylindrically shaped chamber.
6. The separating part was constructed next by welding a piece of mild steel sheet to the main frame at an angle of **45'.**
7. The power cord was fixed to three-prong plugs at the end of a cable which was connected to the other end of the terminals of the electric motor.
8. The blower was connected directly to the source

These components were assembled by using bolts and nuts and by welding in some cases. The finished product was cleaned and painted.

5.2 Summary of Tests Carried out and Results Obtained:

On completion of the construction, the finished product was tested with various quantities of melon seeds and the peeled melon seeds obtained were closely examined and the number of unpeeled seeds as well as the number of un-separated shells was recorded in each sample.

The result showed that the number of unpeeled melon seeds as well as the number of un-separated shells in each sample was very negligible. Based on this, the melon peeling and separating machine was found to be efficient in peeling and separating melon seeds from the shells.

This study is intended to enhance technological advancement and economic growth by imparting the necessary skills on students of Agricultural Engineering, through design and fabrication of machines that are required in mechanizing some of the operations in agricultural production which would have otherwise been carried out by using humans labour.

In this way, rapid solution to problems is enhanced. It is in this regard that the agricultural processing machines, like the designed and fabricated melon shelling and separating machine becomes inevitable.

VI. CONCLUSION AND RECOMMENDATION.

A simple melon seed shelling and separating machine has been fabricated, preliminary test were carried out on the melon sheller and separator to ascertain its performance. The cost, safety, maintainability, durability and efficiency were critically taken into consideration during the design. The results of the tests carried out on the machine showed a very remarkable and promising success as far as the functional requirement of the melon sheller is concerned. The machine is sustainable from the fact that the materials used for its fabrication were locally sourced, thus, the spare parts are locally available.

6.1 Recommendations

In line with the purpose and result of this study, the following recommendations are made:

1. Attention should be paid to locally design and constructed machine is recommended Nigeria for the fact that it is maintainable and sustainable as the parts for its repair and maintenance can be sourced locally.
2. Government, private entrepreneurs and agricultural research institutes should help in the mass production of this machine.

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Effect of Chinese Green Tea on Glumerular Filtration Function of Albino Rats Treated with Gentamicin

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Abstract— *Acute kidney injury (AKI) results from reduction in glumerular filtration rate (GFR) causing the passage of little or no urine. This study investigated the effects of Chinese green tea on glumerular filtrate functions of albino rats treated with gentamicin in view to evaluate its nephroprotective effect. Animals were procured from the animal house of Veterinary Medicine Department University of Nigeria Nsukka. The rats were transported to Biochemistry laboratory, acclimatize for 7 days and randomly assigned into five groups. The rats were fed with commercially prepared pellets (vital feed) and watered ad libitum throughout the duration of the study. Nephrotocity was induced with gentamicin at 80mg/kg for 7 consecutive days with co-administration of camellia sinensis extract. Blood samples were drawn from rats in each groups and were analyzed for biochemical parameters. Results obtained are; from urea (13.08-6.12mg/dl), creatinine (70.08-42.25mg/dl), cystatin C (0.084-0.027mg/dl) and GFR (2.20-1.30ml/mins). Findings reveal that Gentamicin induces nephrotoxicity through induction of oxidative stress and generation of Reactive Oxygen species (ROS). Nephrotoxicity is an acute kidney injury marked by induced GFR and serum accumulation of urea, creatinine and cystatin C. Camellia sinensis contains powerful antioxidants catechins which counters the oxidant effect of gentamicin, thereby ameliorating its nephrotoxicity. Therefore crude extract of Camellia sinnesis has nephro-protective effect and ability to maintain a relatively normal GFR.*

Keywords— Gentamicin, nephrotoxicity, GFR, green tea.

I. INTRODUCTION

Acute Kidney Injury (AKI) is a condition where kidney's glumerular filtration rate (GFR) is reduced and as a result, there is little quantity of urine passed out, this condition is known as oliguria (Schrier et al., 2014). When the glumerulus at the Bowman's capsule is tempered, its filtration function is impaired. This reduced GFR leads to accumulation of certain nitrogenous substances within the body which alters the osmolalic concentration of the blood leading to inflammation (oedoma) which is seen as a common symptom of kidney problem (Mizota *et al*., 2017).

There are various causes of AKI which include infectious diseases, drugs, heavy metals and other toxicants. Some infections, such as septicemia and acute pyelonephritis, can directly injure ones kidneys. Drugs that cause acute kidney injuries include aminoglycoside family, this is a family of antibiotics whose members include streptomycin, clindamicin, gentamicin etc. (Bellomo *et al.,* 2014).

Gentamicin is an aminoglycoside member known potentially to cause AKI when administered consecutively for 7 days (Ratliff *et al.,* 2016). The kind of AKI caused by gentamicin is characterised by oliguria, preturia and inflammation which sometimes

leads to oedema of the limbs. All of these are as a result of low or reduced ultrafiltration or alternatively the reduced Glumerular Filtrate Rate (GFR) (Fenoglio *et al.*, 2019).

GFR is an index used in measuring or indicating AKI. It can be done with the following parameters: urea, creatinine, cystatin C (which are endogenous) and inulin (exogenous) which is only found in plants and is indigestible (Dan *et al*., 2011). Since animals do not metabolise the inulin, whenever an animal takes it into the body, it stays in the body only to be passed out through urine. It is used to check the glumerular filtrate rate (Wołyniec *et al.*, 2018).

Camellia sinensis is a plant native in Asia, China precisely, but now cultivated all over the whole world for its medicinal and beverage importances. It is known to contain certain Phytochemicals especially the antioxidant phytochemicals as polyphenols, and catechins (Prasanth *et al*., 2019). As a result of this reach antioxidant phytochemical constituents, *Camellia sinensis* is now seem important in the prevention and management of the diseases: diabetes, hypertension anti-ulcer etc (Kaushal *et al*., 2019, Ngobidi et al., 2016 ana Kanlaya et al., 2019).

But there are few information available on how the oxidant in *Camellia sinensis* affect the GFR in ameliorating AKI. And this leads us to the current study (Prasanth *et al.*, 2019). This study aimed at determining the effect of effect of chinese green tea on glumerular filtrate functions of albino rats treated with gentamicin.

II. MATERIALS AND METHOD

2.1 Plant material source:

The *Camellia sinensis* leaves was sourced from shop Rite Enugu Nigeria.

2.2 Preparation of plant extracts:

The plant leaves was ground into powder by using a mortar and pestle. Known mass of the powder was macerated in Known volume of ethanol for 48hrs. After then, the extract was first sieved with cheese cloth and later filtered using a Buckner funnel and Whatman NO 1 filter paper. The filtrate was concentrated to dryness by air drying and then stored in an air tight container under refrigeration at 40°C until required.

2.3 Experimental Animals:

Adult albino rats weighing between the range of 180-200g were obtained from Veterinary Medicine Department University of Nigeria Nsuka. The rats were kept in cages in the Biochemistry laboratory of Science Laboratory Technology Department Akanu Ibiam Federal Polytechnic, Unwana and allowed to acclimatise for 7 days before the study. All rats were fed with commercially prepared pellets (vital feed) and watered *ad libitum* throughout the duration of the study.

2.4 Study Design:

Induction of Nephrotoxicity: It was induced by intraperitoneal injection of gentamicin (80mg/ Kg body weight) for seven consecutive days.

2.5 Grouping of animals:

- GROUP 1: Normal control (no Induction and treatment)
- GROUP 2: Negative control (receive gentamicin only)
- GROUP 3: No Induction and treated with 200mg/kg/day of *Camellia sinensis*
- GROUP 4 : Induced and treated with 200mg / kg/ day of *Camellia sinensis*
- GROUP 5: Induced and treated with 400mg/kg/ day of *Camellia sinensis*

All groups received test agents via oral route using a gavage needle once daily for seven days. Both the Induction and administration of test agents took place simultaneously for seven consecutive days.

At the end of the administration chloroform anesthesia was used to sacrifice the animals. Blood sample was collected directly through the cardiac puncture, about 5ml was put into heparinsed container and about 4ml in container free from anticoagulant and allowed to clot for 20 minutes and centrifuged at 4000rpm for 15 minutes. Sera was collected using micropipettes for onward biochemical analysis

III. BIOCHEMICAL ANALYSIS

3.1 Determination of Serum Urea:

Serum Urea was determined Using Urease Enzymatic method as described by Fawcett (1960). Principle Urea in serum is hydrolysed to ammonia in the presence of urease. The ammonia is then measured photometrically by Berthelot reaction.

Urea + H2O Urease 2NH3 + CO2NH3 + hypochlorite + phenol → Indophenol (blue compound)

3.2 Determination of serum creatinine:

Serum creatinine was determined using colorimetric method as described by Henry (1974). Principle Creatinine reacts with picric acid in alkaline conditions to form a color complex, which absorbs at 510nm.The rate of formation of color is proportional to the creatinine concentration in the sample. In the endpoint method the difference in absorbance measurements after color formation yielded a creatinine value corrected for interfering substances.

3.3 Serum cystatin C:

Serum cystatin C assay was made by latex particle enhanced turbidimetric immunoassay. PET kit (13,14) (Dako, Glostrup, Denmark). Concomitant change in the absorbance signal with rabbit antibody against human cystatin C. A reaction between these immunoparticles. The cystatin C concentration of the patient particles of uniform size, chemically coupled and cystatin C in a patient specimen results. Cystatin C PET kit contains polystyrene in the formation of agglutinates and a specimen is determined by interpolation on a calibration curve.

IV. STATISTICAL ANALYSIS

Data obtained was presented as M ± SD (Standard Deviation). Statistical analysis was done using SPSS version 20 for one way ANOVA followed by LSD post hoc test. $P<0.05$ was considered significant.

V. RESULTS

TABLE 1:
GROUP WISE COMPARISON OF UREA, CREATININE, CYSTATIN AND GFR

Group	Urea (mg/dl)	Creatinine (mg/dl)	Cystatin C (mg/L)	GFR (ml/min)
1	6.12 ± 0.93	42.25±2.28	0.027	2.20 ± 0.1
2	13.08 ± 1.68	70.08 ± 3.76	0.084	130 ± 0.06
3	6.46 ± 1.12	48.02 ± 1.36	0.041	1.90 ± 0.03
4	6.81 ± 0.56	52.88 ± 3.27	0.045	1.70 ± 0.02
5	6.29 ± 1.62	49.30 ± 4.20	0.049	1.70 ± 0.09

Serum urea, creatinine and cystatin C increase significantly at $P<0.05$ in group 2 compare with other groups. Conversely, GFR decreases significantly in group 2 compare to other groups. There was slight increment in urea, creatinine and cuystatine C in group 3, 4, and 5 when compared with group 1 (normal control). Conversely, there was slight decrement in GFR of group 3, 4, and 5 compared with group 1.

VI. DISCUSSION

Gentamicin is still considered as an important amino glucoside antibiotic against life threatening infections regardless of it's nephrotoxic effects. This is because of it's high chemical stability in the body. Gentamicin induced nephrotoxicity has been widely used in animal model to study acute renal failure in experimental research (Avila-Carrasco et al., 2021). Regeneration of reactive oxygen specie and oxidative stress has been suggested as the mechanism of Pathogenesis of gentamicin Induced nephrotoxicity. Regeneration of reactive oxygen species induces necrosis of both glomerular filtration rate and impaired reabsorption function. (Weyker *et al.*, 2012).

We found that gentamicin caused significant elevations of serum cystatin C, Urea, creatinine concentrations. The increase in these three parameters, indicates accumulation in the blood stream due to produced glomerular filtration rate. Treatment with *Camellia sinensis*, however, presented very slightly elevation in serum concentration of cystatin C, Urea, creatinine with no statistical significant when compared with the normal control. This finding from *Camellia sinensis* treatment reviews no

accumulation of the parameters quantifier and also could stand as an indication of unaffected glomerular filtration rate (Kaushal *et al*., 2019).

This could further suggest the inhibition of generation of ROS and oxidative stress. *Camellia sinensis* is known to be rich in beneficial polyphenols. Mainly catcheins and their derivatives which are potent antioxidants and could be the reason for the renoprotective anti-diabetic, anti-mutagenic, neuroprotective and anti carcinogenic effects (Prasanth *et al*., 2019). The findings of this study is in agreement with the studies conducted by where gentamicin also leads to increased urea, uric acid, ROS, MDA and creatinine (Dan *et al.*, 2011).

GFR which is the rate at which the nephrone filters the blood in other to excrete waste out from it i also a veritable tool in prediction and monitoring o acute renl faiure. Reduction in GFR value is associated with acute renal failure (Weykerv *et al.*, 2016).

From our study, there was a significant reduction in GFR in the gentamicin control compared with other groups. This suggested that an acute injury to the nephrone especially at the glumerulus where ultrafiltration takes place. This observation was further strengthened by the significant increased serum concentration of urea, creatinine and cystatin C indicating the accumulation due to insufficient ultrafiltration. It could also be observed that the *Camellia sinensis* in the coadministration with gentamicin prevents the suppression of GFR by some margin which is also significant statistically. *Camellia sinensis* is known to contain antioxidant that counters the oxidant and reactive oxygen species generation which leads to nephrone damage and nephrotoxicity nephrotoxicity (Irazabal et al., 2020, Ostermann et al., 2020 and Meng et al., 2019).

VII. CONCLUSION

Gentamicin induces nephrotoxicity through induction of oxidative stress and generation of Reactive Oxygen species (ROS). Nephrotoxicity is an acute kidney injury marked by induced GFR and serum accumulation of urea, creatinine and cystatin C as a result of reduced GFR. *Camellia sinnesis* contains powerful antioxidants catechins which counters the oxidant effect of gentamicin, thereby ameliorating its nephrotoxicity. We therefore conclude that crude extract of *Camellia sinensis* has nephro-protective effect and ability to maintain a relatively normal GFR.

RECOMMENDATION

Further Studies are recommended to purity, isolate, characterise and optimize the lead compound in *Camellia sinnesis* leaf extract towards producing a solution against gentamicin nephrotoxicity.

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