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ASSESSMENT OF AIR QUALITY IN A POULTRY HOUSE

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ABSTRACT

Intensive poultry production results in poor indoor air quality, emission of air pollutants and global atmospheric constituents. The fecal material produced by the poultry is rich in organic matter and nitrogen content and becomes a source of gaseous emissions inside the poultry house. Accumulation of fecal material for 5 months leads to increase in the concentrations of NH_3, H_2S and CH_4 to 21 ppm, 30 ppm and 2.4%, respectively in the poultry house. The frequent assessment of air quality inside the poultry house helps in the scheduling of waste removal ensuring clean air quality for the birds as well as the workers.

INTRODUCTION

Livestock provide essential commodities and services to the majority of the world's population. Demand livestock products are rapidly increasing in developing countries due to urbanization and change in food habits, in addition to the high nutritional needs for animal products. Indian poultry ranks 4th and 5 th in world egg and broiler meat production

Respectively with a total bird population of 1550 million. The combination of intensive poultry production and certain climatic factors sometimes create poor indoor air quality and emit air pollutants. The gases in indoor air of the poultry house such as ammonia NH_3 methane (CH_4). Hydrogen sulphide (H_2S). Carbon dioxide (CO_2) and oxygen (O_2) are of particular importance in view of their deleterious effect on poultry production and occupational human health. The gases NH_3, CH_4 and H_2S arise from the biodegradation of the accumulated

fecal material under anaerobic conditions inside the poultry house. Their emissions particularly during warm and humid conditions are high and may rise to lethal levels due to insufficient ventilation. While O_2 is essential for respiration. CO_2 is a product of respirator} metabolism. The concentrations of these gases are directly related to bird density, type of housing, feed composition and ventilation of the poultry house.

Groot Koerkamp *el al.* (1998) found that NH_3 emissions were *highe*st from poultry houses as compared to those of cattle and swine. Whyte (1993) reported that Nil; in combination with dust is the most significant respiratory hazard to the occupational health of poultry workers. At a concentration of 15 ppm. Nil; is uncomfortable for the workers and above 50 ppm it causes injury. While 30 ppm concentration of the gas in the poultry house affects the general health of the birds reducing egg production and at 0.01% it produces higher incidence of breast blisters and increased water consumption (Mac O North 1990). CH_2 at concentrations above 5% is lethal to the birds besides it is also implicated as a contributor to global warming with a potential green house effect of about 20-30 limes that of CO_2 (Duxbury *et al.* 1993). H_2S at concentrations above 0.05% *ca*uses dea$_t$h of chicken. With a pungent odor it causes irritation of eyes / nose, headache and dizziness in humans at concentrations between 0.01- 0.05% and also causes death al 0.1% H_2S when combines with humidity in the air forms corrosive sulfuric acid and damages metal cages thus reducing their durability. CO_2 at concentrations between 0.1-0.3% O is ideal for poultry and up to 2% is safe for human beings. The concentration of O_2 usually varies between 19- 21 percent while its concentration below 6 % is lethal for birds as well as humans.

The air quality thus requires to be monitored frequently in order to ensure safety of the birds and the workers employed in the poultry farm. Since air quality directly reflects the sanitary and hygienic status of the poultry house its assessment from time to time can be taken as an indicator for scheduling manure removal operations and also for assessing the ventilation requirements.

MATERIALS AND METHODS

A cage layer open side house of dimensions 95x21 feet located at the Poultry Eperimental Station of Acharya N.G. Ranga Agricultural University. Rajendranagar. Hyderabad was adopted for air quality study. Half of the floor area of the shed was taken up by droppings pit of SO cm depth. The layer house housed 700 layer birds of 8 months age. A minimum ventilation rate of 42 cubic meters per minute was ensured throughout the study period that lasted for 5 months. The layer house was cleared of all the fecal material before the commencement of the study. A base line air quality data comprising concentrations of NH , CH , H S, CO and O was obtained using a gas analyzer (model-multi gas monitor PGM-54 of Multi RAF, IR). Three measurements of each of the gas were taken inside the poultry house at three locations 1) near to the entrance 2) at the center and 3) at the end wall. Subsequently the air quality was assessed once in a month in order It) study the effect of accumulation of fecal material on the indoor air quality. The average of the values was considered for correlating the air quality with the accumulation of the fecal matter. The total quantity of the fresh fecal material voided by the birds per day was equal to the daily feed consumption. The composition of the fecal matter was determined as per the

Table 1
Composition of the feed-1 Layer bird

Ingredient	Value (%\w/w)
Maize	45
Deoiled rice bran	14.2
Soya bean meal	25
Riee bran	5
Shell grit	7
Trace mineral mixture	0.1
Dicalcium phosphate	1.3
Sodium chloride	0.3
Vitamin addition	0.1
Calcite powder	2

Table 2
Composition of fresh poultry droppings

Component	% of wet fecal matter	% of dry matter
Moisture	73%	-
Total Solids	27%	-
Volatile Solids	22%	81.5
Fixed solids	5%	18.5
Crude proteien	-	26.8
Total carbohydrate	-	31.4
Ether extract	-	1.2
Uric Acid	5.6%	-
Total Nitrogen	4.3%	-
Ammonia Nitrogen	0.6%	-
Sulfur (as S)	0.3	1.1

Table 3
Efect of accumulation of fecal matter on the concentration of gases

Month	NH3 (ppm)	CH4 (%)	H2S (ppm)	CO2 (%)	O2 (%)	Quantity of fecal matter (kg)	Cumulative quantity of fecal matter (kg)
Base line data	0	0	0	0.17	21	0	0
February	4	0	0	0.17	20	2400	2400
March, 05	4	0.5	0	0.16	20	2200	4650
April, 05	8	1.2	12	0.18	20	2310	6960
May, 05	15	1.5	28	0.17	20	2390	9350
June, 05	21	2.4	30	0.17	20	2370	11720

AOAC, 1975.

RESULT AND DISCUSSION

The birds consumed 100-110 grams feed per day the composition of which is shown in Table 1. The quantity of the fecal material voided by the birds varied between 2250- 2400 kg per month with the total quantity being 11.720 kg at the end of the study period (5 months). The composition of the fecal material was

as shown in Table 2.

Monthly air quality data from February 2005 to June 2005 is shown in Table 3. The baseline air quality of the poultry house showed absence of gases CH_4, H_2S and NH_3, while the concentrations of CO_2 and O_2, were found to be 0.17 % and 21 % respectively. Presence of NH_3, at 4 ppm concentration was detected at the end of the February while CH_4 was observed to be 0.5 % at the end of March. H2S at a concentration of 12 was detected by the end of April. Not much variation in the concentrations of the gases and O_2 was observed, which were 0.17 and 20 % respectively.

Meanwhile towards the end of June 2005, concentration of NH_3 increased to 21 ppm, which was found to be causing burning sensation of eyes in workers. Workers usually spend up to 3 hours a day in the poultry house for routine farm operations such as feeding and egg collection. The levels of other gases such as 1 FS and CM 14 rose to 30 ppm and 2.4%. respectively by the end of June though the were below their deleterious levels unlike that of ammonia. Because of the harmful effect of NH_3 at 21 ppm on the workers the same was considered to be at the maximum allowable level in the poultry house. To prevent any further increase of NH_3, concentration the accumulated fecal matter was removed thereby reducing harm to the poultry workers and the birds. As a result the concentration of the gases CH_4, H_2S and NH_3 in the indoor air of the poultry house was brought down to zero.

CONCLUSIONS

Poultry local mailer that gets collected in the droppings pit inside the poultry house contains high organic matter and nitrogen. As this material gets accumulated the inner layers become anaerobic and develop reducing conditions. Under these conditions the organic matter, unites and the sulfur present in the fecal matter are reduced to CH_4, NH_3 and H_2S gases. respectively. All these gases escape into the indoor air of the poultry house and early rise in concentration of NH_3 to 21 ppm lakes place. At this concentration workers suffer due to burning sensation of eyes and in order to avoid this the fecal mailer can be removed when the NH_3 concentration in the indoor air of the poultry house is around 15 ppm. Thus timely removal of the fecal material based on the indoor Nil; level avoids damage to the health of poultry workers and increases profitability to the poultry farmer.

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