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EFFECT OF HOUSE SPECIFICATIONS AND ITS EQUIPMENT ON BROILER PERFORMANCE

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ABSTRACT

This study was carried out to investigate and evaluate the actual situation of different operation systems used for the most widely broiler houses in Egypt (open houses). Twenty-five broiler houses were selected in Dakhlia governorate to assess the most suitable system. Working performance and unit production of these type of houses were the criterion used in assessment. The studied systems included different house specifications (house length/width ratio, and ventilation area /floor area), bird density and systems of feeding, drinking, heating ventilation, and lighting. The criteria of broiler performance included feed consumption, body weight, mortality and production index. Energy consumption and cost/kg of bird body were also calculated. The length/width ratio of 2.6, ventilation area/floor area of 22 %, auger feeding system, straight-valve drinking system, exhaust fan ventilation system, umbrella gas heating system, 20 Watt fluorescent lighting lamps and 9 birds/m^2 bird density have given the highest performance for the (open system) broiler houses.

INTRODUCTION

Poultry as one of the animal production enterprises is considered as an important part of these enterprises. Recently, poultry production industry in Egypt is considered as one of the most important industries to achieve self-sufficiency in animal protein, especially with the awful increasing of human population. Commercial poultry farms for meat production are wide spread across the country in comparison with egg production farms.

The broiler farms have many different poultry mechanical systems (feeding, drinking, heating, ventilation, and lighting systems) and other environmental control equipment. The performance of these systems are still quit in efficient because of the lack in real bases for selecting and optimizing these equipment, beside the defective in farmers' knowledge and experience.

In order to design any animal building properly, it is necessary to know the purpose for which it is to be constructed (meat and eggs production). In addition the designer must knows the nature and number of units to be housed, size and space required for each, and the conditions required for best operation or production. The designer must also be aware of the normal weather conditions of the area and have knowledge of available materials that are best suited for use under the given conditions.

Ensminger (1992) reported that, the environment may be defined as all the conditions, circumstances, and influences surrounding and affecting the growth, development, and production of a living thing. In poultry, this includes the air temperature, relative humidity, air velocity, ammonia concentration, light, and space requirements. He added that, the recommended temperature at chick level at the edge of the hover is 35 °C for the first week of age, with a reduction of 2.8 ıC weekly until 21.1 ıC is reached the sixth week of age.

Allam (1986), Tuller and Ldw (1988), EL-Hadidi (1989) and Ensminger (1992) suggested that, the relative humidity in broiler houses may be between 50 and 70%.

AEYB (1979) found that, wind speed greater than 0.3 m/s at chicken height is not recommended for chicks under two weeks of age.

Elson (1986) mentioned that, the objective in designing feeding equipment for poultry is to obtain output (body weight for broiler or egg mass for laying hens) with minimum intake. This is especially important with feeding equipment, since feed accounts for about 70% of production costs. Minimizing intake without adversely affecting output of broiler meat or egg means avoidance of waste, spillage and over consumption of feed. He added that, several types of drinking systems are available for use both on the floor and cages. These include troughs, round hanging drinkers, cup and nipple drinkers. All can be operated automatically if connected to a main water supply either directly or at lower pressure from holding tanks. The installation of a filter in the system to avoid blocked valves and consequent flooding is recommended.

EL-Hadidi (1989) suggested that, the suitable lighting intensity for broiler housing is 12.0 Lux at the first, second, and third week of age; 3.0 Lux at fourth and fifth week of age and 12.0 Lux from the sixth week of age.
It is clear that chickens can be grown under light of any color provided the correct intensities of illumination are used. Female broilers are more sensitive to brighter lights and perform best at intensities between 0.7 and 3.0 Lux (Smith, 1990).

Ensminger (1992) stated that, the typical naturally ventilated buildings can be divided in two types as follows; the first one (open sides) have long sides which are partially open, while the second one (enclosed) have all sides closed but have a continuous opening at the high point (normally the ridge) of the building for air exhaust and continuous openings or inlets along the long sidewalls of the building for fresh air. Air entering along the sidewalls (normally under the eaves) of the building is warmed by the heat from the birds in the building and picks up moisture as it rises toward the ridge. The continuous open ridge allows this warm and moist air to escape, thus completing the air exchange process.

The main objectives of the present study were to study and evaluate the actual situation of the most widely broiler houses in Egypt (open system). The approach will lead to select the most suitable systems (feeding, drinking, ventilation, heating, and lighting) in order to increase the working performance and unit production of these types of houses.

MATERIALS AND METHODS

The experimental work was conducted to study and evaluate the effect of different producing systems of feeding, drinking, heating, ventilation, lighting, and other environmental control equipment on broiler performance. It should also be mentioned that the experimental data of this work was collected throughout four years (five batches yearly) from January 1994 up to December 1997. In other words we may say that each batch was replicated four times in the same broiler house and at the same time of year. The average of four reading for each measured variable was considered in data analysis. Variables and design specifications of the twenty-five broiler houses are tabulated in Table (1)

Experimental Procedure:

House length/width ratio:

To study the effect of the house length/width ratio on broiler performance, five houses were selected (houses No. 1 to No.5). It should be mentioned that these five houses are nearly the same in every thing else except the ratio of length to width. The length/width ratios of these houses were 3.6, 5.0, 6.2, 6.7 and 7.7, respectively.

Table (1): Experimental broiler houses specifications.

House No.	Length, m	Width, m	Vent. Area/floor area, %	Feeding system	Drinking system	Vent. System	Heating system	Lighting system
1	40	11	18 %	Manual	L-valve	Window	Gas	60 W incand.
2	50	10	18 %	Manual	L-valve	Window	Gas	60 W incand.
3	58.5	9.5	18 %	Manual	L-valve	Window	Gas	60 W incand.
4	80	12	18 %	Manual	L-valve	Window	Gas	60 W incand.
5	73	9.5	18 %	Manual	L-valve	Window	Gas	60 W incand.
6	45	10	16%	Manual	L-valve	Window	Gas	100 W incand.
7	45	10	18 %	Manual	L-valve	Window	Gas	100 W incand.
8	45	10	20 %	Manual	L-valve	Window	Gas	100 W incand.
9	45	10	22 %	Manual	L-valve	Window	Gas	100 W incand.
10	45	10	24 %	Manual	L-valve	Window	Gas	100 W incand.
11	50	9.5	17 %	Manual	L-valve	Window	Gas	60 W incand.
12	50	9.5	17 %	Chain	L-valve	Window	Gas	60 W incand.
13	50	9.5	17 %	Auger	L-valve	Window	Gas	60 W incand.
14	46	9.5	20 %	Manual	Manual	Window	Gas	60 W incand.
15	46	9.5	20 %	Manual	L-valve	Window	Gas	60 W incand.
16	46	9.5	20 %	Manual	Straight-valve	Window	Gas	60 W incand
17	45	12	20 %	Manual	L-valve	Window	Kerosene	60 W incand.
18	45	12	20 %	Manual	L-valve	Window	Electric	60 W incand.
19	45	12	20 %	Manual	L-valve	Window	Gas	60 W incand.
20	80	12	17 %	Manual	L-valve	Window	Gas	60 W incand.
21	80	12	17 %	Manual	L-valve	Fan	Gas	60 W incand.
22	50	11	22 %	Manual	L-valve	Window	Gas	60 W incand.
23	50	11	22 %	Manual	L-valve	Window	Gas	100 W incand.
24	50	11	22 %	Manual	L-valve	Window	Gas	20 W Fluore.
25	50	11	22 %	Manual	L-valve	Window	Gas	40 W Fluore.

Ventilation area/floor area:

Five ratio houses were also selected (houses No. 6 to No. 10) to investigate the effect of the ventilation area/ floor area on broiler performance. The ventilation area/ floor area of these houses can be seen from Table (3.1) were 16, 18, 20, 22 and 24 %, respectively.

Feeding systems:

In this study brooding feeder (42 cm diameter) was used in the brooding period. On the other hand, the effect of three different feeding systems during the fattening period on the broiler performance was examined. House No. 11 was manual fed using hanging plastic feeder of 40 cm diameter and hanging galvanized feed pan of 36 cm diameter. House No. 12 was equipped by automatic chain feeding system. House No. 13 was equipped with an automatic auger feeding system. All automatic feeding systems have a storage hopper or hoppers at the end of the building and then feed delivered by a mechanized conveyor. The conveyor types are either two flat chain delivering feed around circuits of rectangular section trough, or circular conveyors such as auger. Feeding space also considered in this experiment.

Drinking systems:

In order to investigate the effect of the drinking systems on broiler performance during fattening period, two drinking systems were used which are manual and automatic system. In manual system, eight-liter founts (24 cm diameter) was used in house No.14. On the other hand, two types of automatic drinkers were also used, which, are L-valve round drinker (38 cm diameter) and straight-valve round drinker (38 cm diameter). These two types were used in houses No. 15 and 16, respectively.

Heating systems:

Heating of broiler house may be used during the brooding period, which may take a period of nearly two weeks during summer season, or it may take a period of 3-4 weeks during winter season. To study the effect of different heating systems on broiler performance, three types of heating systems have been used, namely: kerosene, electrical and gas. The three systems were used in houses No. 17, 18 and 19, respectively. Gas fuel was recorded per batch by a kg while, kerosene fuel was recorded per batch by a liter and by kW for electric consumption.

The calorific values of butane gas and kerosene were considered to be about 45600 kJ/kg and 56839 kJ/liter according to (Mitzlaff, 1988 and E.P.S, 1995, in Arabic). The average of on work power is considered to be about 0.074 kWh according to (Ezeike, 1987).

Ventilation systems:

The effect of two different ventilation systems, which are open windows and exhaust fan systems on broiler performance, was examined. In the first one, each open window (360 x 140 cm) consisted of iron mesh surrounded by wooden frame and plastic cover (house No.20). The second system consisted of a half kilowatt exhaust fan (60 x 60 cm and four blades) located in the south side of the house No.21.

Lighting systems:

The effect of two different lighting systems (incandescent and fluorescent bulbs) on broiler performance was examined. The power of incandescent bulbs either 60 Watt (house No. 22) or 100 Watt (house No. 23) whiles the power of fluorescent bulbs either 20 Watt (house No. 24) or 40 Watt (house No. 25).

During the periods of supplemental lighting, the following equations were used to calculate electrical energy used (e lights) to maintain a specified light level according to (Illuminating Engineering Sociate, 1968) as follows.

$$e_{lights} = N_b * h * W_b \quad (1)$$

$$N_b = (A * D_L) / (L * \eta) \quad (2)$$

Where:

e_{lights} = energy used in lighting, W. h;
N_b = number of bulbs;
h = hours of supplemental light, h;
W_b = watts per bulb, W;
A = floor area, m^2;
D_L = lighting intensity, Lux (Lumen/m^2),
L = lumen per bulb, Lumen,
η = efficiency, % .

The energy efficiency and lumens for different types of lamps are shown in (Table 2), as mentioned by (Schuder, 1983).

Table (2): Energy efficiency of lamps.

Lamps	Watts	Hours	Initial lumens	Lumens/ Watt
Incandescent	40	1500	455	11.4
	60	1000	870	14.5
	100	750	1750	17.5
Fluorescent	20	9000	1300	65
	40	15000	3100	77.5

Electrical energy:

Electrical energy for each house is consumed in operating ventilation fans, mechanical feeding systems, water pump and lighting bulbs. It was calculated from measuring line current strength using super clamp meter and knowing rated potential difference according to (Schuder, 1983) as follows:

1-Phase:

$$E_e = A * V \quad (3)$$

3-Phase:

$$E_e = A \,.\, V \,.\, T \,.\, P_f \,.\, \sqrt{3} \quad (4)$$

Where:

E_e = electrical energy consumption, kW.h;
A = line current strength, Ampere;
V = potential difference, Volt;
T = time taken for operation, hr;
P_f = power factor (it was taken as 0.8).

Bird density:

The effect of birds' density on broiler performance was considered and data was calculated from three different farms having three different densities of 9, 10 and 11 bird/m^2.

Cost analysis:

Fixed and variable costs were estimated according to practical evaluation. Fixed costs were depreciation and interest for building and equipment, and taxes and insurance. Variable costs were house cleaning, litter, chicks, ration, medicament, labours, fuel, electricity, water, repair and maintenance, marketing, and others.

Depreciation and interest of investment may be calculated according to Hunt (1968) as follows:

$$R = S\ [1/\ (1+i\ )^n\ -1] \qquad (5)$$

Where:

R = depreciation and interest;
S = total purchase price;
i = annual interest rate;
n = recovery period, years.

Broiler performance indicators:

a) Feed consumption:

Feed consumption of birds for all studied houses was weekly estimated. The daily amount of ration was weight and total weekly ration was calculated as follows:

$$F_t = F_d * 7 - F_r \qquad (6)$$

Where:

F_t = total feed consumption, kg / week;
F_d = daily amount of feed, kg;
F_r =weekly residual feed, kg.

b) Body weight:

Bird's body weight was also weekly recorded. A sample of 100 birds in five replications in each house was weighted and the total weight was used for calculating the average weekly increase in bird's weight.

c) Feed conversion ratio (F.C.R):

The feed conversion ratio was calculated by using the following relationship:

$$F.C.R = F_c / W_t \qquad (7)$$

Where:

F.C.R = feed conversion ratio, dimensionless;
F_c = feed consumption, kg;
W_t = body weight, kg.

d) Birds mortality percentage:

Bird's mortality was measured as the percentage of died birds during the growth period in relation to the total birds at the beginning of each period.

e) Production index:

The production index considered as an indicator for the overall broiler performance of different systems used for the study. It may be calculated weekly according to Saegh (1974) as follows:

$$P.I = (W_t / F.C.R) * 100 \quad (8)$$

Where:

P.I = production index;

W_t = weight of bird, kg;

F.C.R= feed conversion ratio.

It should be mentioned that building heat calculation, ventilation heat loss, and evaporation heat loss were calculated and programmed and will be dealt with in report paper.

RESULTS AND DISCUSSIONS

House length/width ratio:

The effect of different house length/width ratios of 3.6, 5.0, 6.2, 6.7 and 7.7 on broiler performance (feed consumption, body weight, mortality and production index) were investigated and illustrated in Figure (1a-d).

As shown in figure (1a) the feed consumption per bird was increased from a level of 3.510 to a level of 3.700 kg for house length/width ratios of 3.6 to 6.2 respectively, then it was decreased for house length/width ratio of 6.7 and 7.7, respectively.

The observed increase in feed consumption with the increase of length/width ratio up to a level of 6.2, could be attributed to the improvement in house ventilation control which enhanced the ability of birds to consume more rations.

However, with higher length/width ratio the ventilation control become difficult and the feed consumption rate starts to decrease.

The effect of house length/width ratio on other studied factors such as live body weight, bird mortality and production index has taken a similar trends as shown in Figure (1b). The live body weight of bird was increased from 1.522 to 1.761 kg for house length/width ratios of 3.6 to 6.2 respectively, and it was 1.546 and 1.429 kg for house length/width ratios of 6.7 and 7.7, respectively. On the other hands, bird mortality were decreased from 5.2 to 3.4 % for house length/width ratios of 3.6 to 6.2 respectively, and then it was increased to 6.3 and 6.0 % for house length/width ratios of 6.7 and 7.7, respectively as shown in Figure (1c).

For general evaluation of the effect of house length/width ratio on overall broiler performance indicators the production index of the studied broiler houses was calculated. As shown in Figure (1d) the calculated production indexes were increased from 66.00 to 83.81 for the houses with length/width ratios of 3.6 to 6.2, respectively in comparison with 67.33 and 59.53 for the house of length/width ratio of 6.7 and 7.7, respectively.

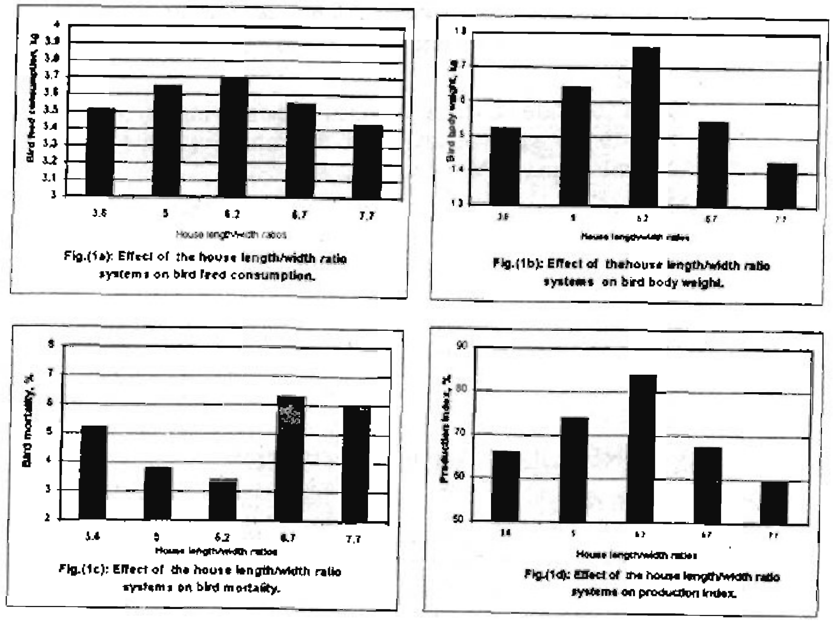

Fig. (1): Effect of different house length/width ratio systems on broiler performance.

Ventilation area/floor area:

The effect of different ventilation areas/floor areas of 16, 18, 20, 22 and 24 % on bird feed consumption, live body weight, bird mortality and production index were examined and illustrated in Figure (2a-d).

As shown in Figure (2a), feed consumption per bird of different ventilation areas/floor areas of 16, 18, 20, 22 and 24 % were 3.370, 3.550, 3.660, 3.730 and 3.510 kg, respectively. This means that, feed consumption of birds increases with the increase of ventilation area/floor area up to a level of 22 % and then starts to decrease again. The observed increase in feed consumption could be attributed to the improvement of house environment conditions in a range suitable for birds. This results show that, the live body weights increased from 1.450 to 1.731 kg for ventilation area/floor area of 16 to 22 % respectively, while it was 1.520 kg at ventilation area/floor area of 24 %.

The corresponded bird mortality levels were decreased from 6.3 to 3.7 % for ventilation area/floor area systems of 16 to 22 % respectively, and it was 5.3 for 24 %.

Similarly, the calculated production indexes were increased from 62.39 to 80.33 for the houses with ventilation area/floor area of 16 to 22 % respectively, and it was 65.82 for the ventilation area/floor area of 24 %. Which means that, the ventilation area/floor area of 22 % is the most suitable for the broiler houses.

Feeding systems:

The effect of Three feeding systems (manual, chain, and auger) on bird feed consumption, live body weight, bird mortality and production index were illustrated in Figure (3a-d).

As shown in Figure (3a) feed consumption for manual, chain, and auger feeding systems were 3.470, 3.590 and 3.670 kg, respectively. The observed difference in feed consumption of the three different feeding systems could be attributed to the specification of each system. For instance, auger feeding system uses a fixed pan round feeders which decreases the crowded of birds around the feeders and give more chance for all birds to feed efficiency without turnover the pans and loosing the ration, this was reflected in better improvement in feed consumption. In contrast, chain feeding system causes the birds to be very crowded at the side of the system in one time and decrease the chance for efficient feed for all the birds which reflected in less improvement in feed consumption. While the manual feeding system can be considered unproper method for birds feeding due to the higher loss of ration during the feeding process as a result of birds crowded around the free pans which causes the pan to turnover and the ration to be lost during the feeding process.

In general, the improvement in feed consumption was very pronounced in increasing live body weight and production index while decreasing bird mortality. The effect of feeding systems on other indicators of broiler performance has taken similar trends, as shown in Figures (3b) and (3c), respectively.

For overall evaluation of the effect of the three studied feeding systems on bird feed consumption, live body weight, bird mortality and production index, the production index of the studied broiler house was calculated. As shown in Figure (3d) the calculated production indexes were 62.87, 72.65 and 74.81 for manual, chain and auger feeding systems, respectively.

Drinking systems:

The effect of three drinking systems of manual, L-valve, and straight-valve drinkers on bird feed consumption, live body weight, bird mortality and production index were illustrated in Figure (4a-d).

As shown in Figure (4a) the feed consumption per bird for manual, L-valve, and straight-valve were 3.320, 3.480 and 3.590 kg, respectively.
The observed difference in feed consumption of the three drinking systems could be attributed to the structure of each system. In case of the straight-valve system, the highest feed consumption of birds may be resulted from the precise control of water discharge to the drinkers, which give a chance for continuous presence water into the drinkers all the time while, the L-valve and manual systems have lower control in water discharge from the vale which causes over water discharge to the drinker and increases the chance for water to re-moisture the litter under the birds.

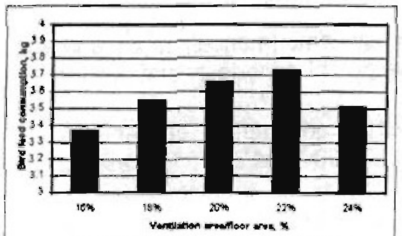

Fig.(2a): Effect of ventilation area/floor area systems on bird feed consumption.

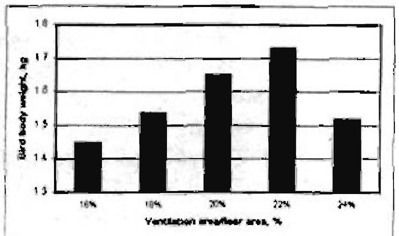

Fig.(2b): Effect of ventilation area/floor area systems on bird body weight.

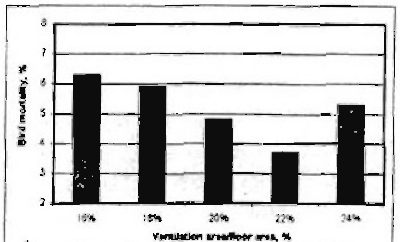

Fig.(2c): Effect of ventilation area/floor area systems on bird mortality.

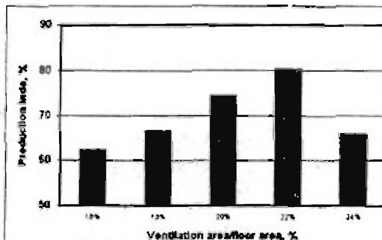

Fig.(2d): Effect of ventilation area/floor area systems on production index.

Fig. (2): Effect of different ventilation area/house area systems on broiler performance.

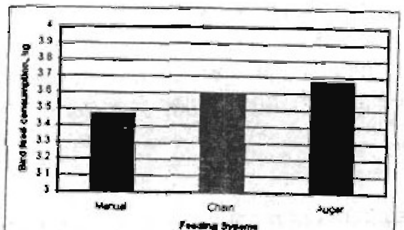

Fig.(3a): Effect of feeding systems on bird feed consumption.

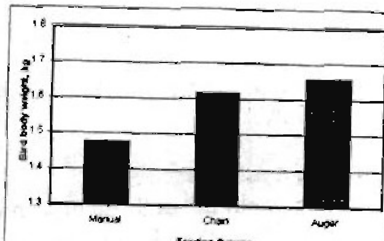

Fig.(3b): Effect of feeding systems on bird body weight.

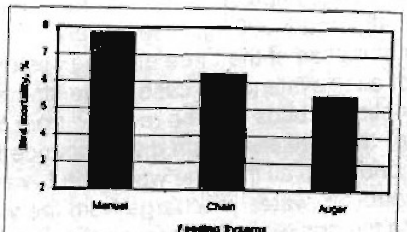

Fig.(3c): Effect of feeding systems on bird mortality.

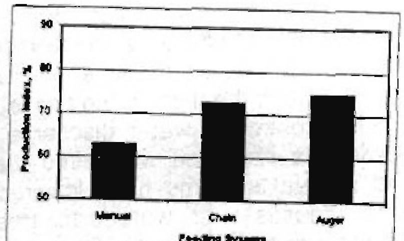

Fig.(3d): Effect of feeding systems on production index.

Fig. (3): Effect of different feeding systems on broiler performance.

The effect of different drinking systems on other indicators of broiler performance is presented in Figures (4b) to (4d). As shown in Figure (4b) the recorded bird body weights were 1.410, 1.480 and 1.574 kg for manual, L-valve, and straight-valve drinking systems, respectively. Contrariwise, the corresponded bird mortality were 6.3, 5.2 and 4.7 % for manual, L-valve, and straight-valve drinking systems, respectively as shown in Figure (4c)

On the other hands, the production indexes for manual, L-valve, and straight-valve drinking systems were 59.88, 62.94 and 69.01, respectively as shown in Figure (4d). The above mentioned results revealed that, the straight-valve drinking system considered the most proper system for producing the highest broiler performance.

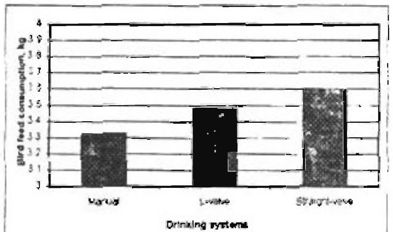

Fig.(4a): Effect of drinking systems on bird feed consumption.

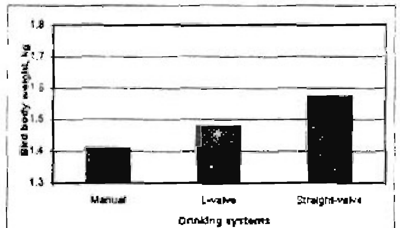

Fig.(4b): Effect of drinking systems on bird body weight.

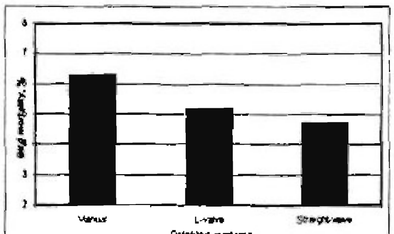

Fig.(4c): Effect of different drinking systems on bird mortality.

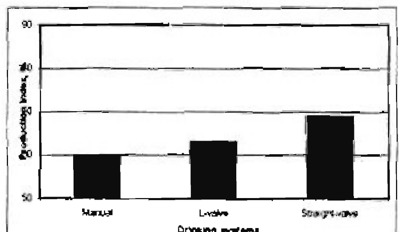

Fig.(4d): Effect of different drinking systems on production index.

Fig. (4): Effect of different drinking systems on broiler performance.

Heating systems:

The effect of three heating systems of kerosene, electric, gas heaters on broiler performance indicators were investigated and illustrated in Figure (5a-d).

As shown in Figure (5a) the recorded feed consumption for kerosene, electric, and gas heating systems were 3.580, 3.670 and 3.760 kg respectively. The increase in feed consumption with the use of gas heating system could be attributed to the full burning of gas without causing any environment pollution into the broiler house, in contrast the kerosene system increases the carbon monoxide and other burning gases which cause environment pollution and decrease the availability of oxygen inside the house and finally the ability of birds to consume more ration.

On the other hands, the corresponded bird body weights were 3.580, 3.670 and 3.760 kg for kerosene, electric and gas heating systems respectively as shown in Figure (5b). While, the bird mortality were 7.8, 5.9 and 4.1 % for kerosene, electric and gas heating systems respectively, as shown in Figure (5c).

On the other hands, as shown in Figure (5d) the calculated production indexes were 61.52, 67.25 and 71.88 for the kerosene, electric and gas heating systems, respectively.

Ventilation systems:

The effect of two different ventilation systems of open window, and exhaust fan on broiler performance were illustrated in Figure (6a-d).

As shown in Figure (6a) the feed consumption per bird for open window, and exhaust fan ventilation systems are 3.750 and 3.860 kg, respectively.

The increase in feed consumption with the use of exhaust fan could be attributed to the continuous presence of oxygen inside the house and on the same time the discharge of carbon monoxide and other gases out side the house, which reduces chance for disease infection and increases the growth rate of healthy birds.

The improvement in feed consumption was very pronounced an increasing of live body weight and production index while decreasing of bird mortality. As shown in Figures (6b) and (6c) the obtained bird body weights was 1.554 and 1.626 kg for open window, and exhaust fan ventilation systems, respectively. While, the corresponded bird mortalities were 6.3 and 4.1 %, respectively. On the other hands, the calculated production indexes were 64.40 and 68.49 for the open window, and exhaust fan ventilation systems, respectively as shown in Figure (6d).

Lighting systems:

The effect of different lighting systems of 60 Watt and 100 Watt incandescent lamps and 20 Watt and 40 Watt fluorescent lamps on broiler performance indicators were studied and illustrated in Figure (7a-d).

As shown in Figure (7a) the feed consumption per bird was increased from 3.650 to 3.940 kg for lighting systems of 60 Watt incandescent and 20 Watt fluorescent respectively. It was 3.880 kg for 40 Watt fluorescent lighting system. The higher birds feed rate of fluorescent lamp in comparison with incandescent lamps may be attributed to the proper light intensity and unit area coverage of this type of light which give a chance for birds to feed longer time.

On other hands, as shown in Figure (7b) bird body weights also increased from 1.538 to 1.746 kg for 60 Watt incandescent lamps and 20 Watt fluorescent lamps respectively, and it was 1.690 kg for 40 Watt fluorescent lamps. While, bird mortality decreased from 4.9 % to 3.7 % for 60 Watt incandescent lamps and 20 Watt fluorescent lamps respectively, and it was 3.9 % for 40 Watt fluorescent lamps as shown in Figure (7c).

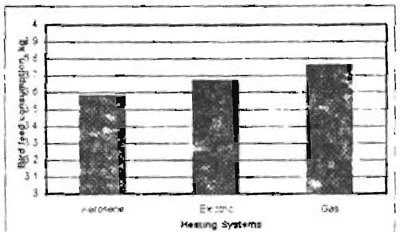

Fig. (5a). Effect of heating systems on bird feed consumption.

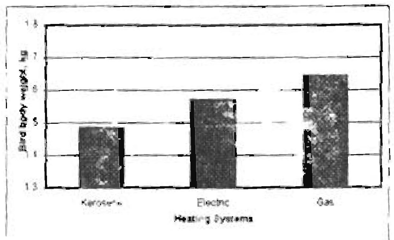

Fig.(5b). Effect of heating systems on bird body weight.

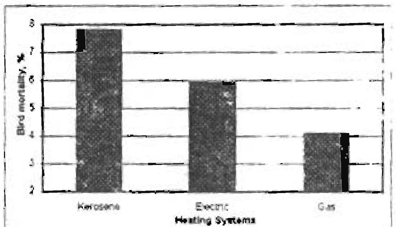

Fig.(5c): Effect of heating systems on bird mortality.

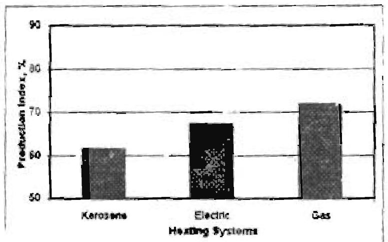

Fig.(5d): Effect of heating systems on production index.

Fig. (5): Effect of different heating systems on broiler performance.

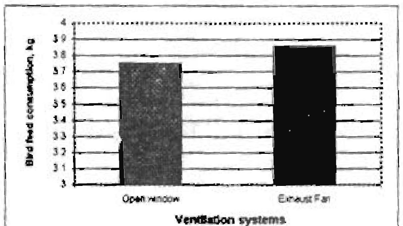

Fig.(6a): Effect of ventilation systems on bird feed consumption.

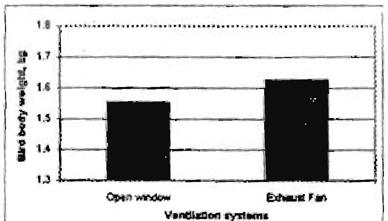

Fig.(6b): Effect of ventilation systems on body weight.

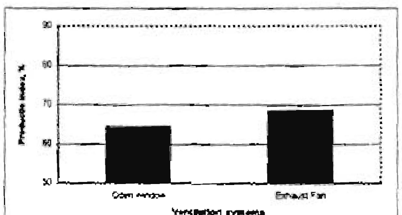

Fig.(6c): Effect of ventilation systems on productio index.

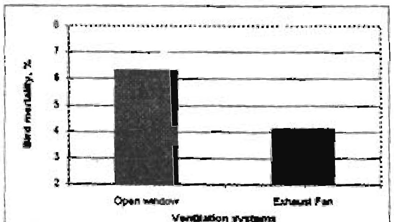

Fig.(6d): Effect of ventilation systems on bird mortality.

Fig. (6): Effect of different ventilation systems on broiler performance.

The production indexes of the four studied lighting systems were calculated and presented in Figure (7d). The calculated production indexes were increased from 64.81 to 77.37 for 60 Watt incandescent lamps and 20 Watt fluorescent lamps respectively, and then it was 73.61 for 40 Watt fluorescent lamps.

Lighting intensity:

Equations (1) and (2) used to calculate the lighting intensity (design light level) of the four-studied broiler houses. The light parameters of these equations include house area, number of lamps, type of lamps and Lumen per lamps.

The effects of the above mentioned parameters on lighting intensity are presented in Table (3). The calculated lighting intensities of the four examined house numbers of 22, 23, 24 and 25 were 17.4 Lux, 35.0, 13.0 and 31.0 Lux for 60 Watt incandescent lamps, 100 Watt incandescent lamps, 20 Watt fluorescent lamps and 40 Watt fluorescent lamps, respectively. Since the suitable required light intensity for broiler houses is 11 Lux as reported by (Timmons, 1987). The studied broiler houses, which represent by one lamp of 20 Watt fluorescent per 50 m^2 and give an light intensity of 13 Lux could be considered as a suitable light intensity for the open system broiler houses.

Table (3): The effect of light parameters on lighting intensity.

House Number	Number of sections	Type of Lamps	Number of lamps	Lighting intensity, Lux
22	11	60 Watt Incandescent	22	17.4
23	11	100 Watt Incandescent	22	35.0
24	11	20 Watt Fluorescent	11	13.0
25	11	40 Watt Fluorescent	11	31.0

Bird density:

The effect of three breeding bird densities of 9, 10 and 11 bird/m^2 on broiler performance illustrated in Figure (8a-d).

As shown in Figure (8a) the feed consumption per bird for 9, 10 and 11 bird/m^2 were 3.670, 3.520 and 3.420 kg, respectively. The above mentioned results revealed that, feed consumption of birds increases with the decrease of bird density. This due to the fact that, lower bird density give a chance for birds to consume more ration as a result of decreasing the competition between them.

The improvement in feed consumption was very pronounced in terms of an increasing in live body weight and production index and decreasing in bird mortality. As shown in Figure (8b) the obtained bird body weights were 1.578, 1.502 and 1.463 kg for 9, 10 and 11 bird/m^2, respectively. While, the corresponded bird mortalities were 4.9, 6.5 and 7.8 %, respectively as shown in Figure (8c).

The production indexes of the studied broiler house also calculated, as shown in Figure (8d) the calculated production indexes were 67.85, 64.09 and 62.58 for 9, 10 and 11 bird/m^2, respectively.

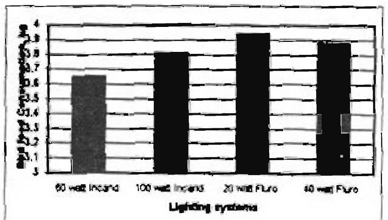

Fig.(7a): Effect of lighting systems on bird feed consumption.

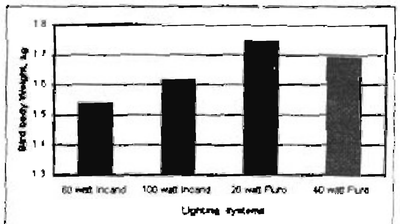

Fig.(7b): Effect of lighting systems on bird body weight.

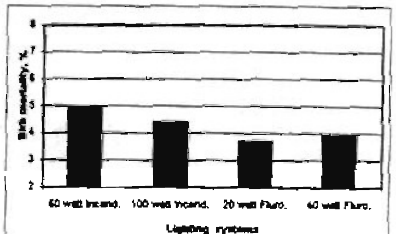

Fig.(7c): Effect of lighting systems on bird mortality.

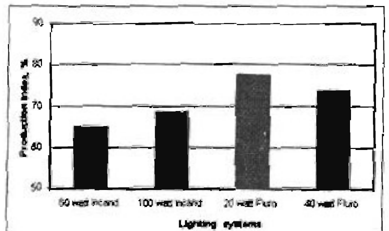

Fig.(7d): Effect of lighting systems on production index.

Fig. (7): Effect of different lighting systems on broiler performance.

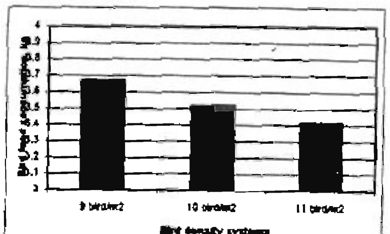

Fig.(8a): Effect of bird density systems on bird feed consumption.

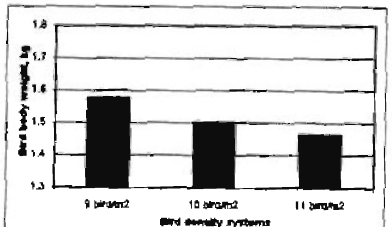

Fig.(8b): Effect of bird density systems on bird body weight.

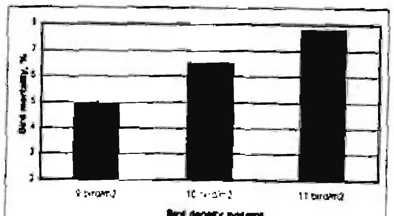

Fig.(8c): Effect of bird density systems on bird mortality.

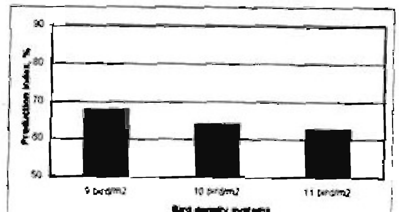

Fig.(8d): Effect of bird density systems on production index.

Fig. (8): Effect of different bird density systems on broiler performance.

Energy consumption and cost analysis:

To asses the proper system for the open broiler houses, the optimum results obtained for each studied parameter were collected and considered as a selected system for the broiler houses. The system was compared with the conventional open system in terms of energy consumption and cost/kg of body weight. The optimum parameters represented the selected system were house length/width ratio of (6.2), ventilation area/floor area of (22 %), auger feeding system, straight-valve drinking system, axial fan ventilation system, umbrella butane gas heating system, 20 Watt fluorescent lamps and bird density of 9 birds/m^2. The corresponded items for the conventional system were house length/width ratio of (5.0), ventilation area/floor area of (20 %), manual feeding system, manual drinking system, open windows ventilation system, kerosene heating system, 60 Watt incandescent lamps and bird density of 10 birds/m^2.

As shown in Table (4), the total calculated energy consumption for operating the selected open system was found to be 1.19 kW.h/ kg of bird body weight. While, the total calculated energy for operating the conventional open system was found to be 2.39 kW.h/ kg of bird body weight. This means that, the total energy consumption was higher for the conventional system in comparison with the selected system by about 101 %.

Table (4): Energy requirements for the conventional and the selected open system broiler houses.

Operating parameters of broiler house	Conventional system energy, kW.h/1000 birds	Selected system energy, kW.h/1000 birds
Lights	55.67	12.68
Human	51.70	25.85
Feeders	---	13.7
Fans	---	43.76
Water pump	7.90	7.90
Heaters	3751.37	1711.77
Total	3866.64	1815.66

The total calculated costs in batch for the conventional and the selected broiler houses were also found to be 3.68 and 3.30 L.E/ kg of bird body weight, respectively. The corresponded net profit was 0.42 and 0.69 L.E/ kg of bird body weight, respectively. This means that, the net profit was higher for the selected system in comparison with the conventional system by about 64 %.

SUMMARY AND CONCLUSION

The results showed that:

(1) Length/width ratio of 2.6, ventilation area/floor area of 22 %, auger feeding system, straight-valve drinking system, exhaust fan ventilation system, umbrella gas heating system, 20 Watt fluorescent lighting lamps and 9 birds/m^2 bird density have given the highest performance for the (open system) broiler houses.

(2) The total energy consumption was higher for the conventional system in comparison with the selected system by about 101 % and the net profit was higher for the selected system in comparison with the conventional system by about 64 %.

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المراجع

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تأثير مواصفات المسكن وتجهيزاته على أداء الطيور

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* معهد بحوث الهندسة الزراعية
** قسم الهندسة الزراعية- كلية الزراعة- المنصورة

اجريت تلك الدراسة لاختيار التصميم الأمثل لمسكن دجاج اللحم من النوع المفتوح من حيث نسبة الطول/ العرض - مساحة التهوية / مساحة أرضية المسكن - اختيار نظم التغذية، السقاية، التدفئة، التهوية، الإضاءة - كثافة الطيور .كما تم أيضا تقدير الطاقة المستهلكة في المسكن والتكاليف الكلية والعائد لكل طائر. ولقد اجريت الدراسة في خمسة وعشرين مزرعة (النظام المفتوح) من مزارع محافظة الدقهلية ، حيث تعتبر من المحافظات الرئيسية في إنتاج بداري التسمين في مصر وذلك فى الفترة من ١٩٩٤ حتى ١٩٩٧م. وقد اعتمد نظام المقارنة للأنظمة المختلفة على تقدير معدل أداء الطيور من حيث:

(١) معدل استهلاك الغذاء (٢) وزن الجسم الحى
(٣) نسبة النافق (٤) دليل الإنتاج

كما تم تقييم معدل الأداء النهائى على أساس دليل الإنتاج حيث انه يستخدم كموشر او دليل لمقارنة الدورات المتتالية لكل نظام. وقد شملت الدراسة ايضا اختيار انسب المعاملات والتى تم الحصول عليها من الدراسة كنظام أمثل للمساكن المفتوحة ومقارنته بالنظام التقليدى الشائع.

وأوضحت نتائج الدراسة أن انسب مواصفات تصميميه لمسكن دجاج لحم من النوع المفتوح كما يلى:

١- نسبة طول/عرض المسكن (٦,٢).
٢- مساحة التهوية/مساحة أرضية المسكن (٢٢ %).
٣- نظام التغذية الميكانيكية بالبريمة.
٤- نظام السقاية الاوتوماتيكية (Straight-valve).
٥- نظام التهوية بالشفاطات.
٦- نظام التدفئة بالغاز.
٧- نظام الإضاءة باللمبات الفلورسنت (٢٠ وات).
٨- كثافة الطيور ٩ طائر/م٢.

وبمقارنة الطاقة المطلوبة فى الدورة للمسكن الأمثل ذو المواصفات سابقة الذكر بمسكن الدواجن التقليدى فقد زادت الطاقة الكلية المطلوبة للمسكن التقليدى بحوالى ١٠١ % بالمقارنة بالطاقة المطلوبة للنظام الأمثل. كما زاد العائد الصافى للمسكن الأمثل بحوالى ٦٤ % بالمقارنة بالعائد الصافى للنظام التقليدى.