J. of Soil Sciences and Agricultural Engineering, Mansoura Univ., Vol 12 (1):9 - 16, 2021

Journal of Soil Sciences and Agricultural Engineering

Journal homepage: www.jssae.mans.edu.eg
Available online at: www.jssae.journals.ekb.eg

An Integrated Unit for Hatching and Rearing Quail

EL-Shabrawy, T. H.[1*] and M. A. Al-Rajhi[2]

[1]Agric. Eng. Dept., Agric. Fac. Mansoura Univ. , Egypt
[2]Agric. Eng. Research institute, Agric. Research Center, Egypt

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ABSTRACT

This study was conducted to compare between the new integrated quail rearing unit with egg hatching sub-unit, and common egg incubator with traditional rearing system for (black Japanese quail and white jumbo quail) at two eggs hatching positions (vertical position with small end up and down). An integrated unit provided with upper egg incubator and furnished rearing battery cage located lower of it. The chicks were reared for 40 days of age in traditional litter floor and in furnished battery cage. The evaluation include the percentage of hatchability, chick weight, growth performance and mortality number of quail. The result indicated that the new incubation unit was able to maintain a high hatching percentage of 78.53 % for eggs of white jumbo quail with vertical egg position with small end down in average of hatching period 17 days. Chicks were growing in normal weight at 6.99 and 8.19 gram and did not suffer from any disability for black Japanese and white jumbo quail eggs, respectively and with vertical position with small end up. At different time intervals the growth performance of quail didn't show significant difference among the treatment viz. common commercial egg incubator and new incubation sub-unit. The mortality number at the first days increases for quails hatched in common commercial egg incubator. The same capacity attached egg incubator saved about 81.25 % of the total cost compared to the common commercial egg incubator, so it is recommended to use the integrated unit for incubating and rearing quail

Keywords **:** Integrated unit – Humidity – Incubating – Rearing – quail – hatching egg.

INTRODUCTION

Domestic quails never incubate their eggs, so in order to increase its populations, artificial hatching is being practiced in many countries. Protein deficiency is a major problem for poor society, while poultry, especially quail, have received less attention relative to other livestock species Aggrey, *et al*. 2003.In this regard, Quail breeding is considered one of the alternative methods of producing meat and competing with broiler as a source of protein with the increasing demand for animal protein. Quail meat and egg has many nutrition benefits, such as vitamin E, protein, minerals, fat, and hormones Tunsaringkarn, 2013. Quail meat excel of its contains more protein than the chicken Ihejirikamba, 2012. The quail egg average production is around 280-300 eggs/year with weights of egg about 10 g Kaur, 2008. Japanese quail eggs and meat be an alternative source of the protein for the poor societies Pankaj, 2016. Quail farming need less breeding cycle began and returns from it. From other hand, quail rearing cost ratio of raising and caring is much lower than chicken farming and higher productivity. Quail birds are known as useful animal models for conducting research due to their need for small breeding areas, so the study parameters can be easily controlled and the low research costs, good meat taste, easy handling and are more disease resistant as compared with the other species of poultry Mady, 1981. Incubation egg process mean the process to eggs fetal incubation until animal's parent hatching it Aru, 2017. The process of hatching eggs and artificial hatchery is important in the intensive production of poultry and the use of such hatcheries is the best way to meet the growing demand for poultry products. The temperature stability during the incubation process of eggs is one of the important matters provided by the parent from his body temperature and keeping the temperature of the eggs at a constant temperature while sitting on the eggs, which is necessary for the completion of the fetus's growth during the specified incubation period. The incubation process aims to sit on the eggs to incubate. Take into account the availability of sufficient moisture to help the eggs hatch during the incubation process. The eggs incubator is a device like a box which can control the humidity, temperature, and other adjustments to encourage stages of fetal growth in the egg until hatch process Umar, *et al*. 2016. In the market there are two main types of incubator (forced air - still air), first one provide with an fan of exhaust to circulate the air, while the second one is using the convection air exchange in and out where cold air will enter and the hot air will come out through the ventilation holes. For rearing Japanese quails especially, the incubation period time is about 17 to 19 days Aru, 2017, the temperature is $36.5^oC - 37.5 \pm 0.5^oC$ Schmitt, 2015 and the humidity range is $50\% - 65\%$ Umar, *et al*. 2016. An egg must be rotated for 45^o every 4 hours in the incubating process, to avoid the egg shell embryo stick Mashhadi, 2012. Incubator still air unit without exhaust fan is unable to circulate the air. Therefore, an exhaust fan important function was used to circulate the air to preserve the level of moisture, oxygen content and heat in the incubator inside area Nakage, 2003. Before putting the egg inside the incubator, it must checked quality first. Thus, if the egg had bad quality, the chance for the egg to hatching process is low. There are many researchers to build

*** Corresponding author.**
E-mail address: elshabrawy@mans.edu.eg
DOI: 10.21608/jssae.2021.152003

the incubator for various egg, such as for chicken Schmitt, 2015 quail Deka, 2016, partridge Nakage, 2003, and other. For the incubating system, researchers developed the incubator to automate the adjustment system, such as the temperature Ohpagu, 2016 humidity Schmitt, 2015 egg reversal Ramli, *et al*. 2015 and other Radhakrishnan, 2014 which based on the micro- controller Ali, 2016, Abdul-Rahaim, 2015 and Garcia-hierro, 2012. Some researchers reported that egg weight and body weight are related Adedokun, 2002 and by selection the body weight could be increasing Brah, 2001. Yoshizaki, *et al*. 2002 have reported that for successful incubation or quality of production of hatched chicks. There are many factors to consider, such as egg turning and its position during artificial incubation. Wilson, *et al*. 2003 It was found that the growth of the embryo inside the incubated eggs passes through the stages of formation throughout the incubation period until the end of its formation and reaching the stage of hatching. Egg position during storage and incubation can interfere with embryo position, affecting chick quality and hatchability. By changing the position of the incubated eggs, the exposed area of the surface of the shell, affects the loss of water from the egg, which affects the completion of hatching in a way. Tiwari and Maeda, 2005.

The purpose of housing birds is to protect them from environmental extremes, which increase mortality or reduce growth, fertility, immunity and egg production. Batteries were used in the poultry industry in the early 1920's. Since beginning of using batteries in raising rabbits and poultry, there is a pronounced increase in the production on economical basis. Although the remarkable advantage of using batteries, the light has been focused on the negative aspects. The major criticisms include the barren environment in addition to the limited exercise, small space allowance and the restrictive behavioral consequences Hane, *et al*. 2000. Many researchers studied the effect of housing systems on productive, behavioral and reproductive traits of poultry Roshdy, *et al*. 2010.Type of housing system is the greatest important factor affecting the performance of poultry. Reared quail in battery cage had higher egg production compared to reared it on littered floor Alam, *et al*. 2008. System of rearing of Japanese quail had no effect on the fertilized eggs significantly Arumugam, 2014. Success in raising quail requires the availability of many factors through careful control of the environmental conditions surrounding the bird. Environmental factors that affect the growth of quail are basically : healthy nutrition, provision of feed and water, temperature control, lighting, good ventilation and breeding density represented by the number of birds in relation to the area Yazgan, *et al.* 1996. Popescu, 2007 showed that the temperature about 35 - 40°C at the young quails age 1 day and rearing temperature about 25 - 27° C in the next elevens day of rearing period, then it must fall about 3 - 4°C / week, and clarify that, at 6 weeks quail rearing period reduced the level environmental temperature to be about 20 - 24°C. Ionita, 2008 Determine the appropriate temperature inside the nursery to receive quail chicks at 1 day about to 37.1 - 37.3 °C, then temperature decreased to be 29.1 - 29.3 ºC in the second growth rearing week and to be about 26.8 - 27.2 °C in the third week of quail growth. Relative humidity inside the growth house of the young quails is related with heat losses and it has a preservation effect at body temperature. Researchers recommended also a satisfactory level of proportional air humidity between 30% and 80%. Khalil, 2009 states that humidity level in the first two weeks of quails growth should be between 50% and 75%. Velcea, 1997 and Popescu, 2007. mentions a humidity level of 70% in housing of young quails growth, humidity level in the first quails growth week must be at 80%, then its value should decrease to be 70%

There is few studies about incubating and rearing quail have been reported, as domestic quails never incubate their eggs. So, we can produce chicks by hatching their eggs artificially through using incubators. Also quails are smaller sized bird, so they can be raised within small place in battery cage.

Therefore, the objectives of the present study was to use local materials and simple electronic components to fabricate and evaluate a low cost integrated unit for incubating and rearing quail. The incubator can control the temperature and humidity, while a manually mechanism was used to reversal the quail eggs for 17 days incubate period until hatching day old chicks from black and white jumbo quail eggs and their rearing up to 40 days of age.

MATERIALS AND METHODS

The present study was carried out at a private farm located at EL-Daqahlia Government- Egypt. The study was divided into three phases. The first phase was collecting of fertile eggs from two species of quail (black and white jumbo), second phase was fabricating and operating an integrated quail rearing unit provided egg hatching sub-unit and compared it with the common commercials till air incubator in hatching process on collected fertile eggs obtained in the first phase of the study and the third phase was rearing of hatched day-old chicks up to forty day-old. Black and white jumbo quails, fertile eggs were obtained from privet quail farm and were used for the first phase of the study. Chicks were housed in litter floor barn compared with integrated rearing unit equipped with necessary drinkers and feeders.

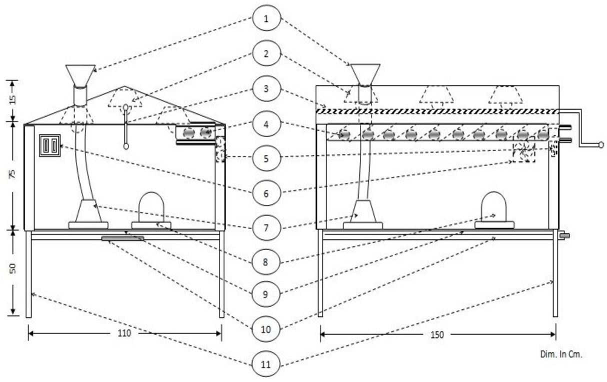
System description and structure: For fabricating of integrated rearing quail unit, a wooden rectangular box illustrated in figure 1 and 2(A and B) is made up. The inside dimensions of battery cage was 140 cm long and 100 cm wide, providing 1.4 m^2 of floor space. Inside the main box there is a wooden tray works as egg incubator and designed according to the size of quail eggs. The tray can hold 200 quail eggs. A support hatching tray was also designed to can be removed and rotate from outside for rotation of incubation eggs.

Rearing battery unit: The integrated unit having a raised wire floors and a shallow dripping drawer for collecting fecal until 40 days of age. A drinker of a capacity about two liter and one 30 cm feeder diameter were used. To prevent the chicks from drowning in drinking water, pebbles were placed in shallow water bowls for the first days of their life rearing period. The feeder was supplied from a feed funnel on the top the battery. At the top of integrated unit are some incandescent tungsten bulbs serving as heaters with blower fan mounted on them to aid circulation of the heat produced by the bulbs and to regulate the speed of air in the incubator.

The integrated unit was constructed also to permit long term maintenance and care of chicks without exposure to environmental factors, it can provide an sufficient fresh air to maintain the humidity level and temperature conditions in order to protect birds from dramatically changes of weather conditions.

The attached hatching tray: The eggs are housed inside of the rearing unit located at the top of it on tray (120 x 41 x 11.5 cm). consists of 3 controlled elements that need to be controlled which are egg movement, humidity and temperature, which makes temperature and humidity inside it to be more consistent and also facilitates, it designed to enable Reaching steady levels of temperature and humidity more quickly is required when there is variation or disturbance in ambient environmental conditions. The heating devices (100 watts incandescent tungsten bulbs) produce heat to raise the incubator temperature to a reference temperature inputted at the set point of the Arduino controller. At the same time the fans circulate the hot and humidity air through out the integrated unit. The structure diagram of the integrated unit is shown in Figure. 1. Nevertheless, sufficient moisture is needed to ensure the embryo eggs do not stick together with the egg shell. In addition, microcontroller was used to monitor and control all of these elements.

Controlled system : The data processed by the controller from sensors and changed the temperature levels controlled from 0 °C to 50 °C as well as the humidity conditions in the incubation unit. The temperature monitored by a screen outside the unit. When the temperature of incubator is lower than 36.5 °C we will turn on the Lamp, and if more than 38.5°C the system we will turn off the Lamp. The humidity also monitored by a screen outside the unit control. When the hatching incubator humidity is lower than 55% the system we will turn on the heater, and if more than 65% the heater will turn off and blower fan work. For maintaining inside battery temperature also the rearing unit floor is made to enable us move it up and down by used a floor-left lever as a hollow handle attached to the frame provides for its manipulation.



1-Feed funnel 5-Circulation fan 9-Perforated floor
2-Tungsten bulb 6-Heat and humidity sensor 10-Drippingdrawer
3-Floor-lift lever 7-Feeder 11-Stands
4-Egg tray 8-Drinker

Fig. 1. The structure diagram of the integrated unit

Fig. 2(A and B) . The integrated quail unit

Methods

The eggs were housed inside of the incubator (hatching tray) located at the top of the rearing integrated unit and in the common commercial incubator. For Incubation of eggs, a number of uniform size eggs were collected from single production day and special care was taken to exclude cracked or very dirty eggs from this study. Before setting all eggs were properly cleaned with luke-warm water solution of mild disinfectant savlon. Before setting of eggs, the incubator box (hatching tray) was thoroughly fumigated by using potassium permanganate and formaldehyde. Manual turning of eggs was done at 4 hours interval up to 15th day of incubation, It has also been recommended by Pankaj, *et al.* (2016) Candling of egg was done on every alternate days by using torch light and one fertile egg was sacrificed to observe the development pattern of embryo. To maintain desired humidity for hatching, a plate of water was kept in the incubation box. The two incubators were maintained at 37.5 C for the entire treatment period. Humidity was adjusted to 50% RH for all incubators during the period 1 to 21 days and 72% for the 21 to 22 day period. All eggs were removed from the incubators at seven days and candled to determine fertility. Chicks were counted and removed from the hatcher on day 22 of incubation. For rearing of produced chicks up to production, after each hatch, produced chicks were immediately transferred to different chicks rearing battery cage or littered floor.

Studied parameters:

-Two species of Japanese quail (black and white jumbo) were studied.

-Two methods of egg incubation [forced air (attached to integrated unit) and still air (Common commercial egg incubator)] were studied.

-Incubated egg positions vertical position with the small egg end up (position A); in vertical position with small egg end down with (position B), with constant egg flipping as illustrated in Fig.3

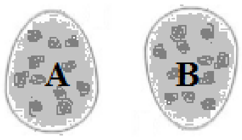


Fig. 3. Egg positions

- Two rearing places (battery cage subunit and littered floor) were studied.

Measurements:

- Egg weight: Data on egg weight (g) were recorded prior to setting eggs in the incubator.
- Hatchability, %: were recorded on the basis of total egg set, %.
- Chick weight, g.: were recorded after hatching by using a digital balance with an accuracy of 0.01 gram.
- Average feed intake, g.: was determined each ten days at the time of weighing the chicks.

-Average body weight gain, g.: All birds were individually weighed each ten days of the experiment and the initial and final body weight of chickens was measured during the experimental period.

- Feed conversion ratio: were calculated as feed consumed divided by quail weight gain during ten days interval.
- Number of mortality: was recorded daily and calculated as a number. The body weight gain was corrected for dead birds.

RESULTS AND DISCUSSION

There were some primary studies to insure suitable temperature inside battery cage, that adapted with different stages of quail age as illustrated in fig.4. To maintain 34°C for the first days the floor of battery was raised up to 45 cm, for 32 °C it raised up to 33 cm, for 30 °C it raised up to 26 cm, for 28 °C it raised up to 18 cm, for 26 °C it raised up to 13 cm and for 24 °C it raised up to 6 cm. All of these primary measurements were taken under well closed room temperature of 22 °C.

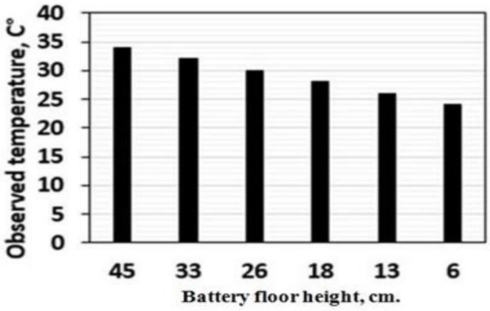


Fig.4. Relation between battery floor height, cm and the observed temperature, C°

Table (1) showed egg weight, hatchability and weight of hatched chicks. Hatchability percent on the basis of total eggs set were (74.76 % and 76.43 %) under egg position A and (76.31 % and 78.53 %) under egg position B for black and white jumbo quail, respectively and under the new incubation sub-unit, while the present of it were (73.23 % and 77.12 %) under egg position A and (75.35 % and 79.15 %) under egg position B for black and white jumbo quail, respectively under common commercial egg incubator.

Table 1. Hatchability traits of eggs incubated under the new incubation sub-unit and the common commercial egg incubator for the two species of quail (black and white jumbo).

Variables	New incubation sub-unit				Common commercial egg incubator			
	Position A (vertical position with the small end up)		Position B (vertical position with small end down)		Position A (vertical position with the small end up)		Position B (vertical position with small end down)	
	Black Japanese quail	White jumbo quail	Black Japanese quail	White jumbo quail	Black Japanese quail	White jumbo quail	Black Japanese quail	White jumbo quail
Egg weight ,g	10.83	11.34	10.84	11.26	10.81	11.21	10.80	11.19
Hatchability on the basis of total egg set, %	74.76	76.43	76.31	78.53	73.23	77.12	75.35	79.15
Chick weight ,g	6.99	8.19	6.56	8.02	6.93	8.15	6.48	7.97

The higher hatchability in the present study might be attributed to the rearing breeding quails in deep litter system as floor rearing may ensure better mating for breeding quails. In the present study chicks weight were (64.54 % and 72.22 %) of the initial egg weight set under position A and (60.52 % and 71.23 %) under egg position B for black and white jumbo quail, respectively and under the new incubation sub-unit, while the present of it were (64.11 % and 72.70 %) of the initial egg weight set under position A and (60.00 % and 71.22 %) under egg position B for black and white jumbo quail, respectively and under common commercial egg incubator. Farooq *et al*. (2001) reported similar weight of the new born chicks (8.06 g) in Japanese quail. Wilson (1991) reported chicks weight to be 62 to 73 % of the initial egg weight set in incubator. The smaller weight of black chicks in the present study might be due to the smaller eggs of this specie. These finding suggested that large sized eggs resulted in better hatching performance as compared to small sized eggs of Japanese quail. Similar findings were also reported by Khurshid *et al*. (2004). Yoshizaki and Saito, (2002) found that incubated of quail eggs at 39 °C in vertical egg position with small end down and turned it every two hours had a 85% hatchability, from other hand the hatchability 63% obtained with eggs placed with their tropical side down with turning, while without turning had only 24% hatchability. Compared with our study results, it was detected that quail eggs presented a higher mean hatch rate for vertical position with small end down (77.34). According to Wilson *et al*., (2003) a major cause of detrimental mal position, especially in broiler hatched eggs, with the small end up; it can also explain the poor hatchability (1.95%) found in Japanese quail eggs incubated in this position. We found that the vertical position with small end up position with turning produced the heaviest chicks (6.99 and 8.19 gram) for black and white jumbo quail, respectively. However, the weight of chicks at hatch can also be affected by other factors, including breed, species, levels of egg nutrient, environment surround the egg and egg weight loss during incubation period, weight of shell and other residues at hatching process, quality of egg shell and incubator conditions similar to (Wilson, 1991).

Table (2) showed the growth performance like average feed intake, average body weight gain and feed conversion ratio of black and white jumbo quail hatched under new incubation subunit and common commercial egg incubator. There was a little increase in the average feed intake, due to feed scattering when breeding hatched quails in deep litter system as floor rearing. Also white jumbo quail consume higher feed than black ones. The average body weight for quails breeds in deep litter system as floor rearing increased than that breeds in new furnished battery cages subunit, due to less predatory and freely motion. At different time intervals the growth performance of quail didn't show significant difference ($P<0.5$) among the treatment viz. common commercial egg incubator and new incubation subunit in the present study. It might be due to the fact that hatching eggs for each type of quail were collected from same parent of uniform size. The recorded results for average feed intake were similar to those of Abd El-Gawad *et al*., (2008). Razee *et al*., (2016) found that for Japanese quails growing rearing system had significant effect on feed consumption. Our results were in disagreement also found that quails body weight be higher in battery cage rearing system compared to the littered floor one.

Table 2. Growth performance of quail.

Treatments			**Time intervals**			
			1st ten days	**2nd ten days**	**3rd ten days**	**4th ten days**
		Average feed intake, g/bird.				
New incubation sub-unit	Furnished battery cage sub-unit	Black Japanese quail	89.87	199.87	375.02	521.43
		White jumbo quail	97.82	207.47	382.58	541.45
	Floor rearing	Black Japanese quail	93.64	218.36	381.39	532.38
		White jumbo quail	111.92	248.98	394.88	554.43
Common commercial egg incubator	Furnished battery cage sub-unit	Black Japanese quail	88.97	189.76	377.45	522.76
		White jumbo quail	98.35	205.45	383.85	539.88
	Floor rearing	Black Japanese quail	97.34	217.67	383.54	530.45
		White jumbo quail	110.97	249.65	390.43	557.54
		Average body weight gain, g/bird.				
New incubation sub-unit	Furnished battery cage sub-unit	Black Japanese quail	48.47	94.28	146.13	180.39
		White jumbo quail	64.34	125.43	174.44	206.14
	Floor rearing	Black Japanese quail	55.17	112.73	155.34	193.18
		White jumbo quail	74.67	126.32	185.43	211.45
Common commercial egg incubator	Furnished battery cage sub-unit	Black Japanese quail	47.46	95.87	148.45	181.67
		White jumbo quail	63.56	122.45	170.56	203.35
	Floor rearing	Black Japanese quail	54.47	111.88	153.64	192.34
		White jumbo	74.64	124.56	186.54	213.57
		Feed conversion ratio				
New incubation sub-unit	Furnished battery cage sub-unit	Black Japanese quail	1.85	2.12	2.57	2.89
		White jumbo	1.52	1.65	2.19	2.63
	Floor rearing	Black Japanese quail	1.70	1.94	2.46	2.76
		White jumbo	1.50	1.97	2.13	2.62
Common commercial egg incubator	Furnished battery cage sub-unit	Black Japanese quail	1.87	1.98	2.54	2.88
		White jumbo	1.55	1.68	2.25	2.65
	Floor rearing	Black Japanese quail	1.79	1.95	2.50	2.76
		White jumbo	1.49	2.00	2.09	2.61

Also, they reported that birds in battery cage reached higher body weight and gained weight faster than birds reareng on littered floor. On the other hand the present results are in agreement with the perception of Ojedapo and Amao (2014) who reported that quail birds rearing in litter floor had significantly heavier weight compared with battery cage housed quails. Akram *et al*., (2000) found that Japanese quail chicks housed under litter floor system gained 27.06 % more weight than those reared under battery cage system with same conditions. We can notice, the response of quails with respect to weight gain was better than rearing birds on the litter floor concerning the battery cage housing system also reported by Pavlovski *et al*., (1992). The quail feed conversion ratio study results were matching with Abdel - Magied (2006), who showed that the Japanese quail feed conversion ratio rearing system housed in battery cage was higher than birds housed on the litter floor. Also, these results were in conflict with study of Padmakumar *et al*., (2000) who showed that the average feed conservation efficiency for Japanese quails rearing in battery cage system and deep litter floor from 5 to 50 weeks of birds age was not affected with type of housing system. Razee *et. al*. (2016) found that rearing system had significant influence on bird feed conversion ratio of Japanese quails growing levels.

Table (3) showed the mortality number of black and white jumbo quail under the new incubation sub unit and common commercial egg incubator. An equal number from each specie was housed on the litter floor and in furnished battery cage attached to the integrated unit to record the number of mortality. The mortality number at the first days increases for quails hatched in common commercial egg incubator, due to more dangerous of the climate while handling chicks from common commercial egg incubator to the breading place, as quail chicks are very sensitive to temperature changes levels than chicken birds.

Also the number of mortality for black quail type was higher, due to week and small chick produced from this specie of quail comparing with white jumbo specie. Also sufficient temperature limit and exposure to cold air leads to throng of young chicks, which leads to the death of young birds and high mortality rates. In general the number of mortality decreases by increasing age for all species and under each method of incubation. This result is in agreement with Razee *et. al*. (2016) who reported that quails rearing system had significant influence on birds mortality rate.

Table 3.The mortality number of quail.

Treatments			Time intervals			
			1st ten days	2nd ten days	3rd ten days	4th ten days
		The mortality number				
New incubation sub-unit	Furnished battery cage sub-unit	Black Japanese quail	2	1	0	0
		White jumbo quail	1	0	0	0
	Floor rearing	Black Japanese quail	1	1	0	0
		White jumbo quail	1	0	0	0
Common commercial egg incubator	Furnished battery cage sub-unit	Black Japanese quail	6	4	1	0
		White jumbo quail	4	1	0	0
	Floor rearing	Black Japanese quail	5	4	1	0
		White jumbo quail	3	1	0	0

Table (4) showed a comparison between the total cost of the integrated unit and the common commercial egg incubator. The total cost of the integrated unit with hatching sub-unit was 900 L.E compared to the common only commercial egg incubator (800 *LE*.). Each of integrated unit and the common commercial egg incubator needs one labor for managing. The same capacity attached egg incubator saved about 81.25 % of the total cost compared to the common commercial egg incubator. This integrated unit lessen the costs of transporting quail from hatching units to breading places and lessen also, the percentage of mortality due to bad weather.

Table 4. Comparison between the total cost of the integrated unit and the common commercial egg incubator.

Specification	Integrated unit	Common commercial egg incubator
The price of the new incubation subunit, L.E.	150	--
The price of the furnished battery cage subunit, L.E.	750	--
Total price, L.E.	900	800

CONCLUSIONS

Present study has shown that the new incubation subunit could be best perform than the common commercial egg incubator for hatching Japanese quail eggs, because quail chicks are very sensitive to temperature while handling chicks from common commercial egg incubator to the breading places. The utilization of this integrated unit in Japanese quail production system provides many advantages such as easy to handle for various kinds of eggs, portable, and the most important is high hatching ability. Also it may be utilized for small scale Japanese quail farming in the rural areas of the developed countries like Egypt. The quail can be reared in the new incubation subunit of integrated unit without evidence of cannibalism. This integrated unit also provides an accurate temperature and humidity condition. This new incubation subunit was indicated to maintain a high hatching rate at average of 78.53 % for eggs of white jumbo and with vertical position with small end down in average of 17 days. This is due to the accuracy of the temperature levels, air intake, humidity and eggs turning. Chicks were developing in normal weight at average of 6.99 and 8.19 gram and did not suffer from any disability for black and white jumbo quail eggs, respectively and with vertical position with small end up. At different time intervals the growth performance of quail didn't show significant difference among the treatment viz. common commercial egg incubator and new incubation subunit. The mortality number at the first days increases for quails hatched in common commercial egg incubator, due to more dangerous of the climate while handling chicks from common commercial egg incubator to the breading place, as quail chicks are very sensitive to temperature than other poultry species. The same capacity attached egg incubator saved about 81.25 % of the total cost compared to the common commercial egg incubator.

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وحدة متكاملة لتفريخ وتربية السمان

طارق حسني الشبراوي عبد الله [1] و محمد علي إبراهيم الراجحي [2]
[1]قسم الهندسة الزراعية ـ كلية الزراعة ـ جامعة المنصورة
[2]معهد بحوث الهندسة الزراعية

تمت هذه الدراسة على عمليتي تفريخ و تربية طائر السمان حيث اتسعت تربية و إنتاج هذا الطائر فى الآونة الأخيرة لما يتميز به من قصر دورة تربيته و استهلاكه القليل من الأعلاف و نسبة تصافى اللحم العالية و ارتفاع محتواه البروتينى. فطائر السمان المستأنس لا يميل للرقاد علي بيضه لاتمام عملية تفريخه لذا فإننا نلجأ الي التفريخ الصناعي لإكثاره و ضمان نسبة فقس عالية وهي العملية المتبعة في الكثير من بلدان العالم. لذا تم تصنيع وتقييم وحدة متكاملة لتفريخ وتربية السمان فى نفس التصميم (بتصميم يقوم على استغلال حرارة تدفئة تربية فروخ السمان فى عملية تفريخ البيض) للحفاظ على فروخ السمان الناتجة من المفرخ أثناء نقلها إلى مكان التربية ، تتكون الوحدة المصنعة الجديدة من مفرخ لبيض السمان في الأعلى وبطارية تربية مجهزة في الأسفل. تم تزويد وحدة التفريخ بحساس للحرارة والرطوبة وذلك للقياس والتحكم في البيئة الداخلية له. كذلك تم استخدام لمبات تنجستن كمصدر للحرارة ومروحة لتوزيع الهواء. حيث تعتمد فكرة المفرخ علي استخدام لوحة اردينو للتحكم في الحرارة والرطوبة بينما تم تصميم ميكانزم يدوي لتقليب البيض وذلك لتجنب التصاق الجنين بالقشرة وشاشة خارجية لتسجيل المتغيرات داخل درج التفريخ و تصميم أرضية البطارية مثقبة للتخلص من الفضلات فى درج سفلى و أيضا يمكن التحكم فى ارتفاعها و انخفاضها للتسريع و رفع كفاءة عملية تدفئة فروخ السمان الصغيرة فى مراحل التربية الأولى بعد تفريخها و ذلك برفع الأرضية و تقريب الفروخ من لمبات التدفئة فى أعلى وحدة التربية .تم اجراء هذه الدراسة للمقارنة بين المفرخ الجديد الملحق بالوحدة المتكاملة وبين المفرخ التقليدي المنتشر في السوق المحلي لنوعين من بيض السمان (الاسود الياباني والابيض الجامبو) تحت وضعين مختلفين للبيض داخل درج التفريخ (النهاية الصغرى للبيض لأعلى أو لأسفل) وتم خضوع صغار السمان المتحصل عليها للتربية الارضية وفي داخل البطارية المجهزة الملحقة بالوحدة المتكاملة وذلك لمدة 40 يوم وشمل التقييم نسبة الفقس و وزن الكتكوت ومؤشر النمو ونسبة الوفيات للسمان. و أوضحت النتائج انه يمكن الحصول علي أعلي نسبة فقس 87.53 % من المفرخ الجديد وذلك للسمان الابيض الجامبو وعند وضع البيض راسيا ونهايته الصغرى موجهه لأسفل لمدة حوالي 17 يوم وتراوح وزن الكتكوت الناتج 6.99 ، 8.19 جرام وذلك للسمان الاسود الياباني والابيض الجامبو علي الترتيب وعند وضع البيض راسيا ونهايته الصغرى موجهه لأعلي. لم يلاحظ اي اختلاف معنوي لمؤشر النمو عند المدد الزمنية المختلفة عند المقارنة بين تربية فروخ السمان بالوحدة المتكاملة وبين التربية التقليدية على أرضية بنشارة الخشب. بينما زاد عدد وفيات فروخ السمان الناتجة من المفرخ التقليدى و التربية على الأرضية مقارنة بالتفريخ و التربية مباشرة بالوحدة المتكاملة و ذلك في الايام الاولي للسمان المفرخ. حيث ادي استخدام المفرخ الملحق الجديد الي توفير 81.25 % من التكاليف الكلية للمفرخ التقليدي المنتشر في السوق المحلي لاستغلال قدر كبير من الطاقة الحرارية المستخدمة فى التربية فى عملية التفريخ داخل الوحدة المتكاملة.