EFFECT OF HOUSING LIGHT SOURCE ON HATCHING PERFORMANCE IN JAPANESE QUAIL

By

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Abstract: *The present experiment was conducted on one hundred and eight females and fifty four Japanese quail males at 2 weeks of age for 34 weeks as experimental period. The objectives of this research were to investigate the effect of different light sources such as incandescent (INC) , fluorescent (FL), and natural light (NL) sources on fertility , hatchability , hatching time by hatched chick percentages, sex , hatching time , chick weight at hatch and at pull out , chick weight loss percentage and daily percentage of embryonic mortality during incubation.*

The results revealed that fertility and hatchability percentages had increased significantly (P<0.01) for eggs produced from hens subjected to INC and FL lights compared to those produced from birds subjected to NL light. Also chicks for FL and NL light sources hatched earlier for about four hours than chicks for INC light, while the last hatched chicks for INC light were later by about three hours than those for FL and NL light sources. Regardless of chick sex, time of hatch for chicks from birds subjected to INC light was significantly delayed (406.74 hrs) as compared to time of hatch from birds subjected to FL light (390.3 hrs) and 394.45 hrs for NL light source. Chick body weight at pull out was larger significantly (P<0.01) for both INC and FL sources compared to those from NL light source. Regardless of housing light source, bird's sex had no significant effect on hatch time, chick body weight at hatch and at pull out and chick weight loss percentage. Besides, hatch time for males was numerically earlier for about two hours than for female ones. The main peak of embryonic mortality had been recorded on 3rd, 6th and the last four days of incubation. Whereas, very minute percentage of embryonic mortality was recorded during the mid phase (7-11 days) of incubation among the all experimental light sources.

INTRODUCTION

Artificial illumination including light quality is crucial in quail management. Incandescent (INC), fluorescent (FL) and natural light (NL) sources are currently being used in poultry production.

Fertility and hatchability appear to be unaffected by artificial sources of illumination in broiler breeders **(Colman and Minear, 1981)**. In addition to, **Ingram *et al.*, (1987)** showed that no significant differences between fluorescent or incandescent lights were observed on fertility and hatchability of eggs. Hatchability and embryonic growth are dependent upon the ability of the eggshell to conduct water vapor **(Burton and Tullett, 1983).** Also, conductance water loss and vital gas exchange may have become more critical effect on hatchability **(Peebles and Brake, 1987)** and related to embryonic mortality **(Peebles and Marks, 1991).**

Several scientists have also concluded that the conductance of the eggshell is inversely related to the length of the incubation period for eggs of a known weight **(Rahn and Ar, 1980).** Also, chick weight at time of hatch was affected by the time of removal from the incubator and length of holding time in the incubation **(Swann and Brake, 1990)**.Likewise, **Reis et al., (1997)** stated that chick weights at hatch and at removal from hatcher were similar for both sexes, but females experienced a higher weight loss in that interval. Embryonic mortality percentages are of great economical importance for the poultry industry because they are components of hatchability. **Shahein (2002)** reported that peaks of embryonic mortality in chicken are known to occur at two periods of incubation, namely in the first week and from fifteenth day onwards. Increased incubator Co_2 levels may have either positive or negative effects on early embryonic mortality depending upon the degree of increase and the length and period of exposure **(Gildersleeve and Boeschen, 1983)**. Also early embryonic mortality may have been a result of insufficient water loss **(Peebles and Marks, 1991).**

MATERIALS AND METHODS

Two hundred and sixteen Japanese quails were used at 2 weeks of age to 34 weeks at Faculty of Agriculture (Saba Basha), Alexandria University during the period from April up to December, 2003. Baby chicks were randomly assigned in growing locally made batteries in three separate rooms. Each one was equipped with separate illumination, such as incandescent and fluorescent compared to natural light . Each battery part was supplied with separate feeders and waterers. At sexual maturity the

birds had been moved to another layer battery. A total of one hundred and eight females and fifty four males was used during the laying stage for all experimental light sources. Each light source treatment had been involved eighteen replicates which comprises two females and one male for each one. Light schedule was used for birds subjected to both incandescent and fluorescent sources but natural program has a natural light and dark through the months of the experiment. Light intensity was measured from the side of the batteries by the digital light meter model (PANLUX- Electronic Louxmeter). Average light intensity was adjusted by reostate key to 5 Lux during the growing period and 12 Lux during the laying period for both incandescent and fluorescent treatments. Bulbous 60-W for incandescent and 22-W for florescent light were used for the rearing and growing periods (2-6 wks) and laying period (6-34 wks) of age. The schedule of light was used as follows: 2-3 wks of age :21 hr light (L) and 3 hr darkness (D) (21L:3D daily), 3-4wks, (18L:6D) , 4-5 wks (15L:9D), 5-6 wks (12L:12D) , 6-7 wks (15L:9D) , 7-34 wks (18L:6D). Feed and water were provided *ad libitum*.

Three replicates of egg groups for each light source were set in Egyptian-made incubator at 37.5°C dry bulb and 28.3°C wet bulb temperatures. Ninety and seventy hatching eggs were used for studying the hatching parameters. Hatching eggs were numbered consequently and weighed before setting in the setter. The time of eggs setting in the incubator was recorded for each treatment to attain the hatch time exactly in hours and considered as zero hours of experiments. All eggs were set and distributed randomly in three trays at different places to reduce possible position effects. On the 15^{th} day (360 hrs) of incubation, all eggs were transferred singly into pedigree hatching nets and then placed into the hatcher for the remainder of the incubation period. Beginning at 376 hrs (15 days and 16 hours) of incubation and at 6-hr intervals thereafter, the hatcher was opened. Chicks that had fully emerged from eggs were removed, wing-banded, weighed to the nearest 0.1 g. and recorded as chick body weight at hatch then placed again to the incubator after recording the time of hatch. Hatching time and body weight at hatch was monitored every six hours after the hatch of first chick. The chicks were left in the hatcher until servicing time (termination of incubation). All chicks were weighed again at the time of removal from the hatcher at 417 hrs (17 days and 9 hours) and this weight was considered as chick weight at pull out. Percentages of hatched chicks for time were expressed as a percentage of the total sound chicks produced. The effect of opening the door was not assessed in any experiment. Chick body weight loss during incubation expressed on percentage bases was calculated. Chicks for either males or females were reared together, and sex

was determined at the end of the 6 weeks of growing period. Reversing back to the enumerating eggs and wing-banded chicks, hatching time for both males and females was compared. Also, chick weight at hatch and chick weight at pull out were determined for both sexes. All percentage data of fertility and hatchability of total eggs were subjected to arcsine square root percentage transformation prior to analyses. Fertility and hatchability percentages were detected. Eggs that failed to hatch and having full opportunity to hatch were broken out and then examined macroscopically to estimate the embryonic development and assigned according to their time of death by days if possible. Embryonic mortality percentage expressed as a percentage of fertile eggs set was recorded every day of incubation.

Statistical Analysis:

Means and standard errors were estimated for each studied trait. Data analyzed using SAS program **(SAS, 1996)** using general linear model, one way design analysis of variance, the following model was used:

$$Y_{ij} = M + L_i + e_{ij}$$

Where

Y_{ij} = observation record,
M = the overall mean,
L_i = is the effect of light sources, i=1-3and
e_{ij} = is the random error

Factorial design (3x2) analysis of variance, the following model was used:

$$Y_{ijk} = M + L_i + S_j + (L*s)_i + e_{ijk\ j}$$

Where

Y_{ijk} = observation record,
M = the overall mean,
L_i = is the effect of light sources, i=1-3,
S_j = is the effect of sex, j=1-2
$(L*s)_{ij}$= interaction between sex and light, ij=1-6
e_{ijk} = is the random error

Significant differences ($P< 0.05$) among treatment means were separated using Duncan's multiple range procedure **(Duncan, 1955).**

RESULTS AND DISCUSSION

Main effects of housing light source on egg fertility and hatchability of total eggs set are presented in Table 1 .Fertility percentage had significant ($P\leq 0.01$) higher values for eggs produced from hens subjected to INC and

for FL lights compared to those produced from birds subjected to NL light, whereas, no significant difference was recorded between INC and FL light sources with the same respect. The same mentioned trend of fertility is true for hatchability of total eggs set as it had increased significantly ($P<0.01$) for INC source and FL light as compared to NL light source. Spectral differences between INC, FL and NL light sources in the current study could play a role on fertility and hatchability of quail. Results in this study are in harmony with those reported by **Ingram *et al.*, (1987)** who found no significant difference in fertility and hatchability for chicken eggs by FL and INC light. Also these results regarding fertility are consistent with earlier report by **Brake *et al.*, (1989)** who noted that fertility was consistently higher in birds reared in INC light as compared to NL light .However our results contrast with those of **Colman and Minear (1981)** who noted that fertility appears to be unaffected by artificial source of illumination in broiler breeder.

Figure 1 illustrates the effect of housing light source on the distribution of hatching time by hatched chicks. Chicks for FL and NL light sources had hatched earlier for about four hours than chicks for INC light, while the last hatched chicks for INC light were later by about three hours than those for FL and NL light sources. It appears from this figure that preponderance values of hatched chicks percentages for FL light were 4.31, 3.77, 3.50, and 3.1% at 386, 405, 384, and 381 hrs hatching time, respectively. Also, these values of hatched chicks percentages for NL light were 4.58 and 3.90% at 405 and 402 hrs hatching time, respectively. Moreover, these values of hatched chicks percentages for INC light were 6.73, 5.92, 3.90, 3.5, and 3.5 % at 405, 400, 409, 410 and 414 hrs hatching time. However, no differences were found between all experimented light sources with respect to lengths of hatch time. All sources of experimented light had recorded 37 hrs as length of hatch time. Discrepancies were found in the literature concerning the hatch time and upon of hatched chicks. Published researches on the percentages of hatched chicks at different hatching times in quail are lacking. Moreover, **Rahn and Ar (1980)** reported that the higher metabolic rate per unit of mass is the reason of shortening the incubation periods for smaller eggs.

Effects of housing light source and sex on average hatch time, chick weight at hatch and at pull out and chick weight loss percentage are shown in Table 2.Regardless of chick sex, time of hatch for chicks from birds subjected to INC light was delayed significantly ($P\leq 0.01$) (406.74hrs) compared to time of hatch from birds subjected to FL light (390.3hrs) and (394.45hrs) for NL light .Moreover chick body weight at hatch for FL light

source was heavier significantly ($p \leq 0.01$) than those for INC and NL light sources. Also chick body weight at pull out was heavier significantly ($P \leq 0.01$) for both INC and FL sources compared to those from NL light source, while there was no significant difference between INC and FL light sources with the same respect. Chick body weight loss expressed on percentage bases was significantly ($P \leq 0.01$) higher for both FL light and NL light as compared to those for INC light. It appears from this table, regardless of housing light source, bird sex had no significant effect on hatch time, chick body weight at hatch and at pull out and chick weight loss percentage. Besides, hatch time for males was numerically earlier for about two hours than for female ones .

The data of interaction between light source and sex reveal that the highest records of hatch time were recorded under INC light source for both sexes compared to other treatments and sexes. The literature revealed that the photoacceleration of hatching time has been documented in chickens (**Lowe and Garwood, 1977**). Also the highest significant interaction values of chick weight at hatch were recorded between FL and both sexes then followed by INC light source and NL light source with both sexes. Moreover, the highest records of interaction were observed for INC and FL light sources as compared to NL light source for both sexes with respect to chick weight at pull out .In addition to that, lowest values of chick weight loss for the interaction between light source and sex were recorded for INC light source with both sexes compared to other values of interaction. It could be concluded from data of this table that chicks which hatched later for INC light source had a lesser percentage of chick weight loss and highest weight at pull out as compared to FL and NL light sources. The results of this research confirm the result of **Shahein (2002)** who noticed that there was no significant difference of hatch time between both sexes in chicken. Also in chickens, **Resi *et al* ., (1997)** reported that male and female chicks had similar initial and final weight and reported that difference in the time spent in the hatcher will differently affect the chick weight depending on the sex. While, **Whiting and Pesti, (1983)** published that male chicks were heavier than females.

Figure 2 illustrates the effect of housing light source on daily percentage of embryonic mortality during incubation. Embryonic mortality percentages expressed as fertile eggs are not uniformly distributed over the course of incubation. Generally the main peaks of embryonic mortality had been recorded on 3rd, 6th and the last four days of incubation. It appears from this figure that each light treatment exhibits different pattern of embryonic mortality, where eggs from hens receiving the NL light recorded relatively a

higher percentage of embryonic mortality on 3rd and 6th days of incubation (3.70 and 4.94%), respectively. Whereas, eggs from hens exposed to FL and INC sources compared to NL light exhibit a higher percentage of embryonic mortality during the later stage of incubation (14 – 17 days). Furthermore, FL light had a higher percentage of mortality compared to other light sources on 14, 16 and 17th days of incubation (3.58, 1.65 and 2.75%), respectively, while for INC light on 15th day of incubation mortality was 1.94%. Whereas, very minute percentage of embryonic mortality was recorded during the mid phase (7–11days) of incubation among the all experimented light sources. The results of increasing embryonic mortality of Japanese quail during the late stage of incubation are consistent with earlier reports by **Vilchez *et al.*, (1990).** Several explanations were reported regarding the embryonic mortality during early and late stages of incubation for different poultry species. **Christensen and McCorkle (1982)** indicated that eggs with embryos dying late in incubation have decreased in conductance rate. Also, **Christensen (1983)** showed that a possible mechanism to explain late embryonic mortality in large domestic turkey eggs was asphyxiation from inadequate gas exchange. Whereas, **Gildersleeve and Boeschen (1983)** reported that insufficient water loss of environmental and CO_2 concentration could affect the embryonic mortality during the early stage of incubation eggs.

In our opinion the differences in embryonic mortality during incubation could be due to different factors which affect the shell thickness and finally affect egg weight loss which in turn affect the embryonic development and mortality.

Table (1): Effect of housing light source on egg fertility and hatchability percentages of Japanese quail ($\overline{X}$ + SE)

Traits / Light sources	Fertility	Hatchability of total eggs
Incandescent (INC)	95.98±1.24[a]	77.61±2.55[a]
Fluorescent (FL)	94.73±0.84[a]	82.54±4.50[a]
Natural light (NL)	54.54±1.81[b]	47.09±2.86[b]
Significant :	**	**

a and b means within each column with different superscripts are significantly different (P< 0.05).

** Significant at P < 0.01

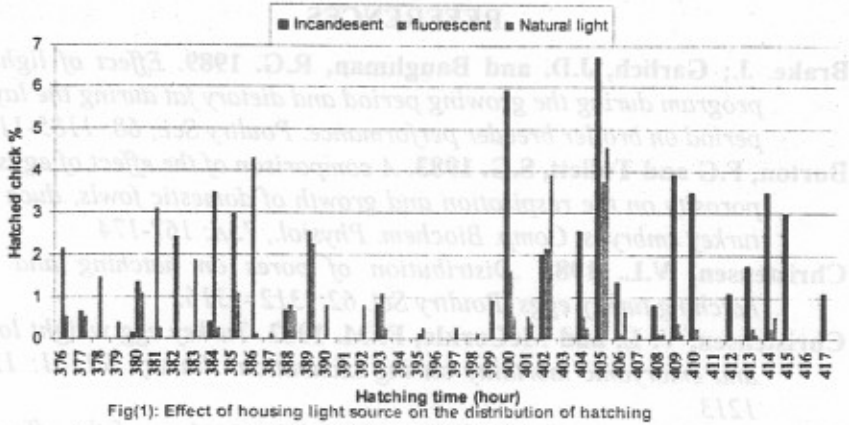
Table (2): Effect of housing light source and sex on hatch time, chick weight and chick weight loss ($\overline{X}$ + SE)

Traits / Main effect	Hatch time (hr)	Chick weight (g)		Chick weight loss (%)
		at hatch	at pull out	
Light source:				
Incandescent (INC)	406.74±0.85^{a}	8.21±0.07^{b}	7.24±0.07^{a}	11.70±0.50^{b}
Fluorescent (FL)	390.31±0.89^{c}	8.60±0.07^{a}	7.18±0.06^{a}	16.89±0.74^{a}
Natural light (NL)	394.45±1.73^{b}	7.75±0.10^{c}	6.59±0.10^{b}	14.83±0.86^{a}
Significant :	**	**	**	**
Sex :				
Male (M)	396.05±0.93	8.35±0.07	7.12±0.06	14.60±0.59
Female (F)	398.24±1.06	8.29±0.06	7.11±0.06	14.54±0.63
Significant :	N.S.	N.S.	N.S.	N.S.
X interaction:				
Light X sex :				
INC X M	406.06±1.20^{a}	8.17±0.01^{b}	7.23±0.11^{a}	11.33±0.97^{c}
INC X F	407.17±1.15^{a}	8.23±0.09^{b}	7.25±0.09^{a}	11.93±0.55^{c}
FL X M	390.63±1.04^{b}	8.61±0.09^{a}	7.21±0.08^{a}	16.19±0.78^{ab}
FL X F	389.93±1.52^{b}	8.58±0.10^{a}	7.14±0.01^{a}	17.72±1.32^{a}
NL X M	394.72±2.41^{b}	7.78±0.16^{c}	6.53±0.17^{b}	15.97±1.51^{ab}
NL X F	394.17±2.49^{b}	7.72±0.13^{c}	6.63±0.12^{b}	13.93±0.97^{bc}
Significant :	*	*	*	*

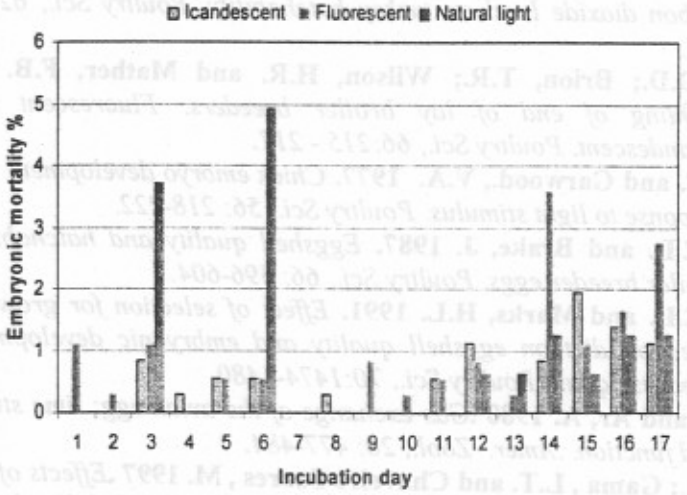
a,b and c Means within each column for each effect with different superscripts are significant different ($P < 0.05$)

* Significant at $P < 0.05$.

** Significant at $P < 0.01$



Fig(1): Effect of housing light source on the distribution of hatching time by hatched chicks percentages



Fig(2): Effect of housing light source on daily embryonic mortality expressed as the fertile eggs during incubation

REFERENCES

Brake. J.; Garlich, J.D. and Baughman, R.G. 1989. *Effect of lighting program during the growing period and dietary fat during the laying period on broiler breeder performance. Poultry Sci., 68: 1185-1192.*

Burton, F.G and Tullett, S.G. 1983. *A comparison of the effect of eggshell porosity on the respiration and growth of domestic fowls, duck and turkey embryos. Comp. Biochem. Physiol., 75A: 167-174*

Christensen, V.L. 1983 *.Distribution of pores on hatching and non hatching turkey eggs .Poultry Sci. 62:1312 -1316.*

Christensen, V. L. and McCorkle, F. M. 1982. *Turkey egg weight losses and embryonic mortality during incubation. Poultry Sci. 61: 1209-1213.*

Colman , M.A. and Minear, L.R. 1981 *.A comparison of the effects of fluorescent versus incandescent lighting on the reproductive performance of two strains of broiler breeder. Poultry Sci., 60:1642.*

Duncan, D.B., 1955. *Multiple Range and Multiple F-test. Biometrics, 11: 1-42.*

Gildersleeve, R.P. and Boeschen, D.P. 1983. *The effect of incubator carbon dioxide level on turkey hatchability. Poultry Sci., 62: 779-784.*

Ingram, D.D.; Brion, T.R.; Wilson, H.R. and Mather, F.B. 1987. *Lighting of end of lay broiler breeders: Fluorescent versus incandescent. Poultry Sci., 66:215 - 217.*

Lowe, P.C. and Garwood., V.A. 1977. *Chick embryo development rate in response to light stimulus. Poultry Sci., 56: 218-222.*

Peebles, E.D. and Brake, J. 1987. *Eggshell quality and hatchability in broiler breeder eggs. Poultry Sci., 66: 596-604.*

Peebles, E.D. and Marks, H.L. 1991. *Effect of selection for growth and selection diet on eggshell quality and embryonic development in Japanese quail. Poultry Sci., 70:1474-1480.*

Rahn .H. and Ar, A. 1980 *.Gas exchange of the avian egg: time structure and function. .Amer. Zool., 20: 477-484.*

Reis , L.H.; Gama , L.T. and Chaveiro Soares , M. 1997 *.Effects of short storage conditions and broiler breeder age on hatchability, hatching time and chick weights .Poultry Sci., 76: 1459-1466*

SAS, Institute, 1996. *SAS Users Guide: Statistics. SAS Institute Inc. Cary, NC, USA*

Shahein, E.H.A. 2002. *Factors affecting hatchability and their relation to embryonic development in local chicken strains. Ph. D. Thesis, Fac. Of Agric., Kafr El-Sheikh, Tanta University, Egypt.*

Swann, G.S. and Brake, J. 1990. *Effect of incubation dry-bulb temperatures on time of hatch and chick weight at hatch. Poultry Sci., 69: 887-897*

Vilchez, C.; Touchburn., S.P.; Chavez, E.R. and Chan, C.W. 1990. *The influence of supplemental corn oil and fatty acids on the reproductive performance of Japanese quail (Coturnix coturnix japonica). Poultry Sci., 69:1533-1538.*

Whiting, T.S. and Pesti, G.M. 1983. *Effect of the dwarfing gene (dw) on egg weight, chick weight and chick weight: egg weight ratio in a commercial broiler strain. Poultry Sci., 62: 2297-2302.*

الملخص العربى

تأثير مصدر إضاءة المسكن على أداء التفريخ فى السمان اليابانى

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أجريت هذه الدراسة بأستخدام ١٠٨ انثى و٥٤ ذكرا من السمان اليابانى عند عمر أسبوعين وأستمرت التجربة حتى عمر ٣٤ أسبوع . أستهدفت الدراسة معرفة تأثير كل من مصادر الإضاءة المختلفة كالمصباح العادى والفلورسنت والإضاءة الطبيعية على كل من نسبة الخصوبة والتفريخ وزمن الفقس لكل من جنسى كتاكيت السمان وزمن الفقس ووزن الكتاكيت عند الفقس وعند الخروج والفاقد فى ورن الكتاكيت وكذلك نسبة النفوق الجنينى اليومى داخل ماكينة التفريخ.

أظهرت النتائج زيادة معنوية لنسبة الخصوبة والفقس للبيض المنتج من الإناث المعرضة للمصباح العادى والفلورسنت مقارنة بتلك المنتجة من الطيور المعرضة للإضاءة الطبيعية .كان فقس الكتاكيت الناتجة من الأمهات المعرضة للإضاءة الفلورسنت والإضاءة الطبيعية مبكرا بحوالى ٤ ساعات عن تلك الناتجة من الطيورالمرباه تحت إضاءة المصباح العادى بينما تأخر الفقس لبيض الطيور المعرضة للمصباح العادى حوالى ثلاث ساعات مقارنة بالإضاءة الفلورسنت والإضاءة الطبيعية و بغض النظر عن الجنس كان زمن الفقس لبيض الطيور المعرضة للمصباح العادى متأخر معنويا(٤٠٦,٧٤ ساعة) مقارنة ببيض الطيور المعرضة للفلورسنت (٣٩٠,٣ ساعة) والإضاءة الطبيعية (٣٩٤,٤٥ ساعة). كان وزن الكتاكيت عند الخروج اعلى معنويا بالنسبة للمصباح العادى والفلورسنت مقارنة بمصدر الإضاءة الطبيعية. وبغض النظر عن مصدر الإضاءة ولن يكن هناك

تأثير معنوي على زمن الفقس ووزن الجسم عند الفقس وعند الخروج والفاقد فى وزن الكتاكيت لكـــلا من الذكور والإناث ولكن رقميا كان فقس الذكور مبكرا عن الإناث بحوالى ساعتين.

كما سجل النفوق الجنينى لكل مصادر الإضاءة المستخدمة أعلى نسبة نفوق جنينى فى كـــل من اليوم الثالث واليوم السادس من العمر وكذلك الأربعة أيام الأخيرة من زمن التفريخ وسجلت الفتـــرة من ٧-١١ يوما أقل نسبة نفوق جنينى.