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Full Length Research Paper

The effect of egg storage containers and duration of storage on the hatchability of eggs and chick quality

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Two experiments were conducted at Alemaya University poultry farm to evaluate the effect of the five egg storage containers and durations identified through a preliminary survey used for egg storage on the hatchability of egg and chick quality. The hatchability of total eggs was significantly affected by the interaction of storage containers and durations in both experiments. Except the eggs stored in Teff grain the hatchability of eggs kept in other containers did not fall below 50 per cent in experiment I on 12 days of pre incubation storage. The hatchability of total eggs stored for the first 8 days did not show significant variation for all the containers. At the end of 20 days of pre-incubation storage, the hatchability of total eggs from all containers was below 20 per cent. Similar trend was also observed in the hatchability of fertile eggs during experiment I. The hatchability of fertile eggs kept in all containers was below 30 per cent at the 20 day of pre-incubation storage. During experiment II, clay pots and cartons showed better hatchability of fertile eggs for 16 days of pre incubation storage period . The hatchability of fertile eggs linearly declined with increasing storage period the rate of decline being highest beyond 16 days of storage (for both experiments). Little variation in the percentage of quality chicks was observed among the storage containers during experiment I. The percentage of quality chicks linearly declined with increasing pre-incubation storage period and variation was higher on the 16 days and beyond of storage time in both experiments. In both experiments, the percentage of quality chicks obtained from all containers did not significantly vary until the day 12 of pre-incubation storage. The results from this study leads to the conclusion that carton, basket and clay pots in that order could be the best alternatives of containers investigated and 16 days of storage is most appropriate holding time for pre incubation storage during either dry or wet seasons of the year for a good egg quality and hatchability results.

Key words: Hatchability/, egg storage period/, Traditional egg/ storage methods, Alemaya University, chicks quality.

INTRODUTION

The majority of poultry in Ethiopia are raised under traditional system of production. These birds contribute eggs for hatch and consumption (market). Alemu (1995) stated that collecting agents gather together larger numbers of eggs for sale in markets of larger towns and cities; and where distances to markets are long, there is marked deterioration of egg quality. This means, normally eggs require some storage time before it is used either for incubation in the hatchery or for human consumption. On the other hand previous literature (Wilson et al, 2003) noted that hatching eggs are not usually incubated immediately after lay. Eggs are thus, normally stored at the hatchery until sufficient space is available during which these eggs may deteriorate in their quality owing to a number of contributing factors involved in storage (Fasenko 1997).

After surveying of the rural poultry production system in the central high lands of Ethiopia, Tadelle (1996) reported that materials for setting eggs are either clay pots, cartoons, bamboo baskets, or even depression made in the ground; with Teff and barely straw are used for bedding material in all systems. Various factors related to storage methods can affect the hatchability and quality of eggs during storage.

This may be due to the different storage methods prac-

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ticed by farmers since eggs decline in quality and hatchability very easily from the time of laying. These factors, therefore, justify the need to conduct research in the area of egg storage practices by surveying the different storage methods operating in the system; and to test some of the most common practices there by to develop some simple techniques which may possibly minimize such quality and hatchability losses. Thus, this study had two parts Experiment I and II which were conducted in May and August (dry and wet seasons respectively) in year 2000. The objectives of the experiment were to assess the effect of different storage methods of eggs using available local resources on hatchability and chick quality in different seasons of the year.

MATERIALS AND METHODS

Two experiments were conducted at the AU poultry farm in May and August 2000. Based on the results of the survey, five different materials used for egg storage and five storage durations (days) were used to test their individual and/or interaction effects on the qualities and hatch abilities of eggs. The five storage containers used for the experiment were: Plastic egg trays used as control, bamboo basket with Teff straw used as bedding, carton with sawdust used as bedding, clay pot with Teff straw used as bedding, polythene bag, teff grain kept in clay pot. The storage durations were 4, 8, 12, 16 and 20 days. Except the plastic egg trays (the control), all the storage containers were arranged in two replications in one room of the AU poultry farm to simulate the local storage conditions. The control (plastic trays) was kept in the cold egg store of the poultry farm.

All eggs were obtained from white leghorn layers having equal age, in similar laying stage and kept under the same standard management of the AU poultry farm. Eggs were collected twice per day (following the usual procedure of the farm) at 11: AM and 5: PM using plastic trays. Eggs from four consecutive collections were used for each of the storage durations. Storage periods were calculated from the time the eggs were allocated to the storage containers.

At the end of each storage period, and after sampling eggs for quality assessment, the remaining eggs were set in an incubator following conventional incubation procedures. Then, eggs from each treatment combination were randomly set in setting trays, which were assigned a position in the incubator at random. Eggs were candled on the 18th day of incubation. Clear eggs with no developing embryos were identified and recorded. Records were kept on setting trays holding eggs from the different treatment combinations. To prevent the mixing up of chicks after hatch, each setting tray was divided into four compartments using cartons and randomly reassigned a position in the hatchery for final hatching. Unhatched eggs from each of the treatment combinations were broken to identify infertile ones, stage of development of dead embryos from fertile eggs. If the broken out eggs were found containing blood rings, they were considered as fertile and early dead. North (1984) stated that if the vascular system is advanced far enough when the young embryo dies, the blood will circulate to the outer edges of the blood vessels and coagulate there, leaving a blood ring.

Hatchability results were calculated from two views: Hatchability from total eggs set and hatchability from fertile eggs. In both cases, the mean hatchability for the different storage materials and durations were computed and expressed as percentages.

Quality of chicks was graded by visual examination based on the quality standards described by North (1984). Accordingly, chicks that were not malformed, with no unhealed navels, not dehydrated, physically active, stand up well and look lively were considered as good quality chicks. The mean percentage of quality chicks obtained was calculated by expressing the number of quality chicks as percentage of the total number of chicks hatched.

A factorial experiment using 2 by 5 in a completely randomized design with five replications was used. Whenever the ANOVA revealed significant differences among the treatment means, Duncan's Multiple Range Test (DMRT) was used to separate the means. Data analysis of the experiment was performed using computer software (MSTAT, 1990).

RESULTS AND DISCUSSION

Hatchability

The storage containers, durations and their interactions significantly affected ($P<0.001$) the hatchability of total eggs during both experiments. As shown in (Table 1), the hatchability of total eggs set linearly decreased with increasing holding period. Eggs kept for 4 and 8 days the hatchability did not vary significantly for all containers and in either experiments; but variation was highly significant beyond 8 days of storage. This is in line with the resulted obtained by Fasenko (1997) that eggs stored for more than seven days are prone to deterioration in quality. The hatchability of eggs stored in Teff grain was the lowest in both experiments at the end of 20 days of pre-incubation periods while eggs kept in polythene bags sharply fall from 64 percent at 12 days of storage to 27 percent at 16 days and reached zero at the end of 20 days of pre-incubation holding. In the experiment II, a non-significant but increasing trend in percent hatchability of total eggs was observed for eggs stored in basket, clay pot and polythene bag for 5 and 8 days.

The interaction effect of storage containers and duration on percentage hatchability of total eggs during ex-

Table 1. Effects of pre-incubation storage duration (days) on percent hatchability of eggs during experiment I.

Storage Duration (Days)	% Hatchability (experiment I)	
	Total eggs	**Fertile eggs**
4	88.3a$^{\Psi}$	89.5a
8	83.4a	84.3ab
12	72.3b	81.8b
16	41.7c	44.5c
20	14.7d	17.5d
Significance	***	***
s.e.m. (±)	2.094	1.950
C,V. %	12.07	10.64

Table 2. Effects of pre-incubation storage containers X duration interaction on the percent hatchability of total eggs during experiment I.

	Storage durations (days)				
Containers	**4**	**8**	**12**	**16**	**20**
Control	86abc$^{\Psi}$	86abc	69cde	56efg	44g
Baskets	86abc	93a	88ab	73bcd	0i
Cartons	86abc	93a	87ab	44g	11hi
Clay pots	93a	79abcd	71bcde	50fg	22h
Polythene	86abc	86abc	75bcd	11hi	6i
Teff grain	93a	64def	44g	17hi	6i
Containers X durations interaction ***					
s.e.m. (±) = 5.13					
C.V. (%) = 12.07					

$^{\Psi}$Means followed by the same letters within rows and columns are not significantly different; ***= significant at 0.1% level of probability; s.e.m. = standard error of the mean; c.v. = Coefficient of variation.

Table 3. Effects of pre-incubation storage containers X duration interaction on the percent hatchability of total eggs during experiment II.

	Storage durations (days)				
Containers	**4**	**8**	**12**	**16**	**20**
Control	74ab$^{\Psi}$	82a	64bc	54cd	45d
Baskets	55cd	64bc	55cd	55cd	9fg
Cartons	82a	64bc	90a	60bcd	19ef
Clay pots	74ab	82a	74ab	55cd	19ef
Polythene	64bc	82a	64bc	27e	0g
Teff grain	82a	64bc	55cd	45d	19ef
Containers X durations interaction ***					
s.e.m. (±) = 5.13					
C.V. (%) = 12.27					

$^{\Psi}$Means followed by the same letters within rows and columns are not significantly different; ***= significant at 0.1% level of probability; s.e.m. = standard error of the mean; c.v. = coefficient of variation.

periment I and II is given in (Table 2 and 3) respectively. In experiment one eggs stored in all containers for the first 4 days did not show significant variation in hatchability of total eggs. The hatching of eggs stored for

Table 4. Effects of pre-incubation storage containers on chicks' quality (Experiment I and II).

Storage containers	Percentage of quality chicks	
	Experiment I	Experiment II
Control	87.3a	87.5a
Baskets	65.1b	63.5b
Cartons	96.1a	76.7ab
Clay pots	76.5ab	66.0b
Polythene	78.3ab	72.5ab
Teff grain	63.5b	90.9a
Significance	**	*
s.e.m. (±)	6.258	6.62

Ψ= Means within columns followed by common letters are not significantly different from each other; **= significant at 1%; ***= significant at 0.1%; s.e.m. = standard error of the mean.

Table 5. Effects of pre-incubation storage durations (days) on percentage quality chicks.

Storage duration (Days)	Percentage of quality chicks	
	Experiment I	Experiment II
4	92.3ab	93.1a
8	93.7a	87.0a
12	81.8ab	88.3a
16	75.4b	75.1a
20	45.8c	37.5b
Significance	***	***
s.e.m. (±)	5.712	6.04
c.v. (%)	25.43	26.22

Ψ= Means within columns followed by common letters are not significantly different from each other; ***= significant at 0.1%; s.e.m. = standard error of the mean; c.v. = co-efficient of variation.

a period of 16 days in containers, basket and clay pot, showed better hatchability results in that order for experiment I. The hatchability of total eggs stored in basket, carton and clay pot and baskets did not fall below 50 percent until the end of 16 days of pre-incubation storage in experiment I and II. This agrees with the findings of Yalin and Siegel (2003) who observed that eggs stored for more than 15 days prior to incubation had poor quality and low embryonic liveability. According to these researchers, this has happened because of the fact that there has been a trend (P= 0.08) for reduced lung weights during embryonic development for eggs stored for more than 16 days before incubation. On the other hand, lower than 50% hatchability results were observed for eggs kept in all containers during the 20 days of holding in both experiments. That means, cartons, basket and clay pot would provide a better alternative storage containers and 16 days of storage time for pre-incubation holding periods.

Chick Quality

Unlike their interaction, both storage containers and storage durations showed significant (P<0.05) effects on the percentage quality of chicks during experiment I (Table 5) Chicks of lower quality were obtained from eggs stored beyond 16 days (Table 6) .

The significant effect (P<0.05) of storage containers X durations interactions on the percentage of quality chicks during the second experiment is shown in (Table 6). As indicated in the stated Tables the mean percentage of quality chicks were above 50 percent until the 16 days of pre-incubation holding. On the other hand, no quality chick was obtained form eggs stored in basket, carton and polythene bags when the holding period increased to 20 days. This low quality chicks and poor hatchability might be due to prolonged storage duration exceeding 16 days during pre-incubation period; this is supported by (Christensen et al., 2003 and Fesko, 1997).

Table 6. Effects of pre-incubation storage containers X duration interaction on the mean percent quality of chicks (Experiment II).

	Storage durations (days)				
Containers	**4**	**8**	**12**	**16**	**20**
Control	88a[Ψ]	100a	100a	75a	75a
Baskets	84a	84a	84a	67a	0b
Cartons	100a	100a	100a	84a	0b
Clay pots	88a	68a	75a	50a	50a
Polythene (E)	100a	100a	88a	75a	0b
Teff grain (F)	100a	71a	84a	100a	100a
Containers X durations interaction *					
s.e.m. (±) = 13.34					
C.V. (%) = 26.22					

[Ψ]Means followed by the same letters within rows and columns are not significantly different; *= significant at 5% level of probability; s.e.m. = standard error of the mean; c.v. = coefficient of variation

CONCLUSION

From this study it could be observed that storage durations had more pronounced effects on the majority of the parameters under study.

Optimum quality and hatchability results might be expected when the storage duration is less than 16 days for all types of containers.

It could be observed from experiment I that eggs kept in polythene bags and Teff grain lost more than 80 percent of their potential hatchability when the pre-incubation storage period was extended beyond 12 days. All the quality parameters were affected by the stated storage conditions which subsequently affect the economics of producers and consumers desirable egg quality standards.

The hatchability of eggs kept in polythene bags sharply fall from 64 percent at 12 days of storage to 27 percent at 16 days and reached zero at the end of 20 days of pre-incubation holding. In the experiment II, increasing trend in percent hatchability of total eggs was observed for eggs stored in basket, clay pot and polythene bag for 5 and 8 days.

Eggs stored for a period of 16 days in containers, carton, basket and clay pots showed better hatchability results in that order in experiment II. On the other hand, better hatchability results were observed from eggs kept in containers and basket and clay pot during the 16 days of holding in experiment I.

Unlike their interaction, both storage containers and storage durations showed significant effects on the percentage quality of chicks during experiment I. In conclusion, it was recommended that egg containers basket and clay pot container could .for during dry season storages while carton, basket and clay-pot could be a good alternative for wet season and at holding period of 16 days for good quality eggs and for better hatching results.

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