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Analysis of Storage Time for Merawang Chicken Eggs *(Gallus Gallus)* against Hatchability: A Systematic Review

Analisis Lama Penyimpanan Telur Ayam Merawang (Gallus Gallus) terhadap Daya Tetas: Tinjauan Sistematis

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Abstrak

Ayam Merawang memiliki potensi untuk dikembangkan, baik sebagai ayam petelur lokal maupun ayam pedaging lokal. Daya tetas dan kualitas telur tetas dipengaruhi oleh cara penyimpanan, waktu penyimpanan, tempat penyimpanan, suhu lingkungan, suhu inkubator, pembalikan selama penetasan. Penyimpanan yang terlalu lama menyebabkan mutu dan daya tetas menurun sehingga sebaiknya telur disimpan tidak lebih dari 7 hari. Penelitian ini bertujuan untuk menganalisis lama penyimpanan telur ayam kampung Merawang *(Gallus gallus)* terhadap daya tetas. Metode penelitian: Pencarian literatur dilakukan secara sistematis melalui database PubMed, NCBI, Google Scholar dengan menggunakan kata kunci yaitu, "Masa Penyimpanan, Telur Ayam, Merawang *(Gallus Gallus),* Daya Tetas". Berdasarkan kata kunci tersebut, artikel yang diperoleh diseleksi terlebih dahulu dengan menetapkan beberapa kriteria inklusi. Berdasarkan hasil pencarian di database PubMed, NCBI, Google Scholar dengan menggunakan kata kunci yang telah ditentukan, diperoleh 15400 artikel untuk kata kunci "Waktu Penyimpanan Telur Ayam Merawang *(Gallus Gallus),* Daya Tetas". Semua artikel diseleksi kembali berdasarkan kriteria inklusi dan eksklusi dan diperoleh sebanyak 23 artikel yang memenuhi kriteria inklusi. Dari hasil penelitian dapat disimpulkan bahwa lama penyimpanan 9 hari (P5) menunjukkan daya tetas, fertilitas tinggi dan kematian embrio terendah. Perlu penelitian pada hewan lain untuk penelitian selanjutnya.

Kata kunci: Daya Tetas; *Gallus Gallus;* Kesehatan Masyarakat; Masa Penyimpanan; Telur Ayam Merawang

Abstract

Merawang chicken has the potential to be developed, both as local laying hens and local broilers. Hatchability and quality of hatching eggs are influenced by storage method, storage time, storage area, ambient temperature, incubator temperature, reversal during hatching. Storage that is too long causes the quality and hatchability to decrease so eggs should be stored no more than 7 days. The purpose of this study was to analyze the length of storage of Merawang chicken eggs *(Gallus gallus)* on hatchability. A literature search was carried out systematically through the PubMed, NCBI, Google Scholar databases using keywords, namely, "Storage Period, Chicken Eggs, Merawang (Gallus Gallus), Hatchability". Based on these keywords, the articles obtained were first selected by setting several inclusion criteria. Based on the search results in the PubMed, NCBI, Google Scholar databases using predetermined keywords, 15400 articles were obtained for the keywords "Storage Time of Merawang Chicken Eggs (Gallus Gallus), Hatching Power". All articles were reselected based on inclusion criteria and exclusion and obtained as many as 23 articles that met the inclusion criteria. From the results it can be concluded that the storage time is 9 days (P5)showed hatchability, high fertility and lowest embryo mortality. Need research on the other animal for future research.

Keywords: Gallus Gallus; Hatchability; Merawang Chicken Eggs; Public Health; Storage Period

Introduction

Indonesia is very rich in flora and fauna potential that needs to be developed. One potential that deserves to be developed is the potential of livestock resources, especially single livestock such as local poultry (chicken), one of which is Merawang chicken. The existence of Merawang chicken, viewed from the aspect of germplasm resources, is a form of local chicken diversity typical of Indonesia which has the potential to be bred and can be cultivated commercially so that it can help meet community nutrition, especially for animal protein and can increase farmers' income (Nataamidjaya and Setioko, 2002) .

According to Imam and Rahayu (2001), Merawang chicken has the potential to be developed, both as local laying hens and local broilers. The population of native chickens in 2014 throughout Indonesia reached 286,538 (temporary figures) and increased (3.52%) compared to 2013 with a total population of 276,777. Chicken egg production in 2014 was 197,391 (temporary figure) eggs, an increase of 1.42% when compared to egg production in 2013 which was 194,620 eggs (Directorate General of Livestock and Animal Health, 2014).

Merawang chicken has characteristics including having a medium posture, calm and docile and has a high adaptability. The advantage of this chicken is that it matures quickly and starts laying eggs at the age of 5.5 months. The qualitative characteristics of this chicken are that it has reddish-brown feathers all over the body, yellow shanks (Research Center for Superior Livestock and Forage for Sembawa Animal Feed, 2014). According to Abubakar *et al.,* (2005), egg production of female Merawang chickens is on average 160 eggs/head/year higher than other local chickens. Furthermore, also explained by Rahayu (2003), that Merawang chicken also has the privilege of not incubating the eggs, therefore, efforts to get Merawan chicken offspring can be done by hatching with an incubator.

Hatchability and quality of hatching eggs are influenced by storage method, storage time, storage area, ambient temperature, incubator temperature, reversal during hatching. Storage that is too long causes quality and hatchability to decrease so eggs should be stored no more than 7 days (Raharjo, 2004). The results of Daulay *et al.,* (2008) showed that the age of hatching eggs that were good according to the results of the study was 1 day old with a hatchability of 83.33%, the age of hatching eggs that exceeded 1 week of storage according to the results of the study was very low with hatchability by 27.08%. Meanwhile, according to the results of Pinau's research (2012), eggs hatched at 1-2 days old resulted in a hatchability of 85.94%, while eggs stored at 7-8 days were 54.69%. This is also supported by Zakaria's research (2010), which states that the length of egg storage does not affect the fertility and hatching weight of chicks, but does affect the percentage of hatchability. The purpose of this study was to analyze the length of storage of Merawang chicken eggs (Gallus gallus) on hatchability.

Material and Method

A literature search was carried out systematically through the PubMed, NCBI, Google Scholar databases using keywords, namely "Storage Period of Merawang Chicken Eggs *(Gallus Gallus),* Hatchability". Based on these keywords, the articles obtained were first selected by setting several inclusion criteria

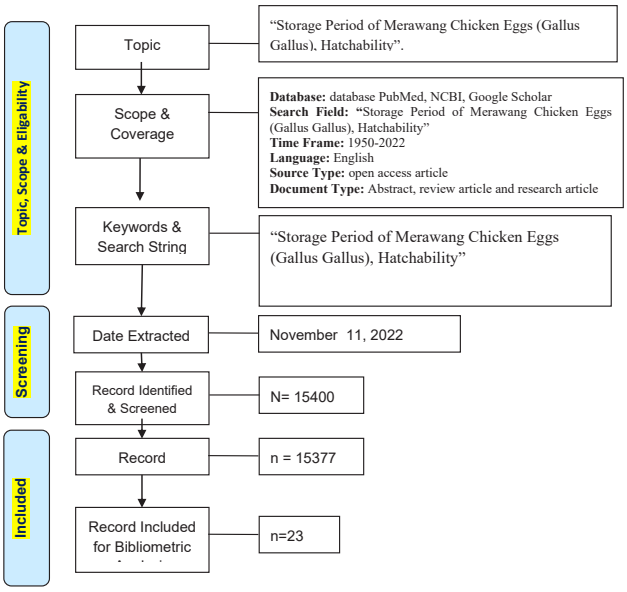

Figure 1. Flow diagram of the search strategy (Source: Herlina, *et al.,* 2016).

Supplementary Table 1 Prisma Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introduction
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methods
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Figure 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methods
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methods
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methods
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Methods
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methods
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Methods
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methods
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Methods
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Methods

Section and Topic	Item #	Checklist item	Location where item is reported
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Methods
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Methods
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Methods
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Methods
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Methods
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Result
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Result
Study characteristics	17	Cite each included study and present its characteristics.	Result
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Result
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Result
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Result
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Result
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Result
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Result
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Result
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Result
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion
	23b	Discuss any limitations of the evidence included in the review.	Method
	23c	Discuss any limitations of the review processes used.	Method
	23d	Discuss implications of the results for practice, policy, and future research.	Conclusion
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Method
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Method

Section and Topic	Item #	Checklist item	Location where item is reported
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Method
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	-
Competing interests	26	Declare any competing interests of review authors.	-
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Method

including journals are not paid / free articles, research results focus on "Storage Period of Merawang Chicken Eggs *(Gallus Gallus),* Hatchability". Articles that do not meet the inclusion criteria are eliminated and articles that meet the criteria will be analyzed to obtain data.

Result

Based on the search results in the PubMed, NCBI, Google Scholar databases using predetermined keywords, 15400 articles were obtained for the Lama Penyimpanan Telur Ayam Merawang (*Gallus Gallus),* Daya Tetas. All articles were re-selected based on inclusion criteria and exclusion and obtained as many as 23 articles that meet the inclusion criteria.

Table 1. The results of the analysis of the diversity of treatments observed on the variables of different egg storage times in Merawang chicken eggs (Gallus gallus)

Variable	F. hitung	KK (%)
Fertility	0,47tn	24,28
Hatchability	0,81tn	18,21
Hatch Time	1,79tn	0,94
Hatching Weight	28,04**	4,38

Description: **: Very Significant Effect; mr: Influence Not Real (Source: Herlina, *et al.,* 2016).

Table 2. The results of the analysis of the Least Significant Difference Test (LSD) and tabulated data on the long storage treatment of Merawang chicken eggs (Gallus gallus)

Variable Observed	Treatment						Score BNT	
	P1	P2	P3	P4	P5	P6	5 %	1%
Fertility (%)	75,00	70,84	70,84	62,50	79,17	66,67		
Hatchability (%)	93,75	81,25	85,42	95,00	95,00	79,17		
Hatch Time (days)	19,95	20,26	20,15	20,10	20,23	20,30		
Hatching Weight (g)	37,50cC	36,14cC	32,50bB	32,69bBC	29,39aAB	27,63aA	2,77	3,51
Embryo Death	6,25	18,75	14,58	5,00	5,00	20,83		

(Source: Herlina, *et al.,* 2016).

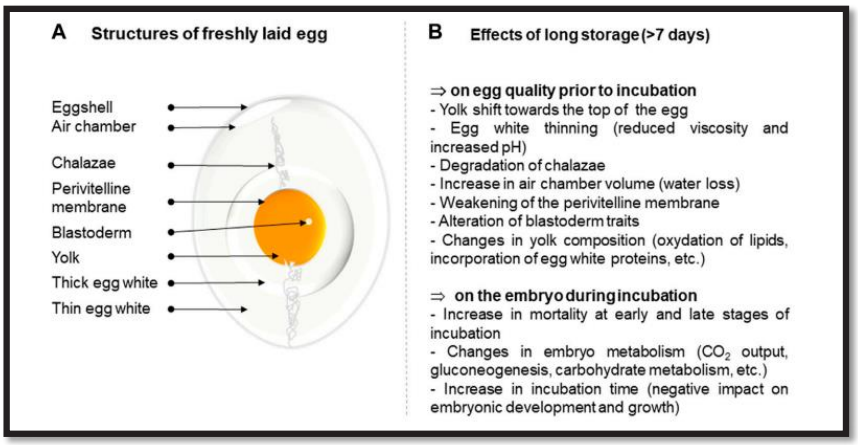

Figure 1. The impact of protracted preservation on egg quality and embryo development. (A). The composition of a newly deposited egg. (B). Long-term storage's effects on several egg parameters (Source : Adriaensen, 2022).

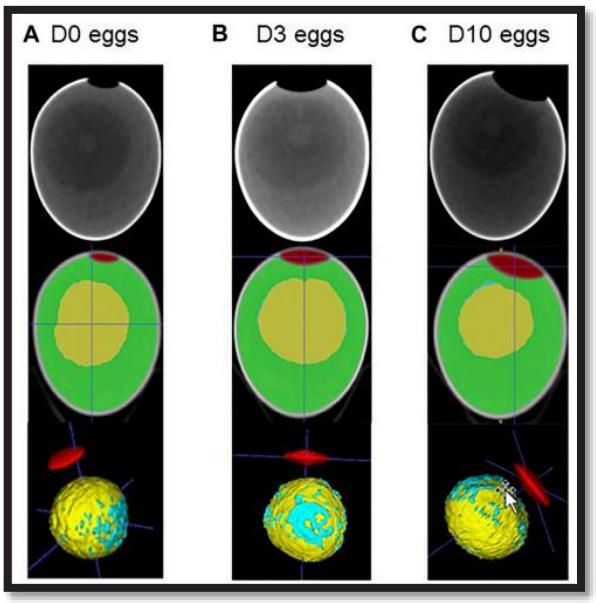

Figure 2. A, B, and C, respectively, show CT images of fertilized eggs that have been preserved for 0 days, 3 days, and 10 days. (Source: Nasri, et al 2020)

Table 3. Egg properties are affected by egg storage.

	Storage duration (days)			*p* Value	Trend during storage
	D0	D3	D10		
Egg weight (g)	56.73 ± 2.29	56.35 ± 2.05	56.05 ± 2.21	0.787	–
Eggshell strength (N)	37.35 ± 5.82	39.51 ± 6.19	34.85 ± 4.06	0.196	–
Yolk index	0.43 ± 0.03^{a}	0.41 ± 0.03^{ab}	0.30 ± 0.03^{b}	**0.023**	↘
Yolk colour	6.27 ± 0.48	6.25 ± 0.37	6.35 ± 0.44	0.935	–
Egg yolk weight (g)	15.53 ± 0.99	15.82 ± 0.78	16.26 ± 0.74	0.130	–
Haugh units	87.30 ± 4.34^{a}	80.01 ± 3.06^{b}	74.57 ± 0.44^{c}	**<0.0001**	↘
Egg white pH	8.53 ± 0.32^{a}	9.20 ± 0.08^{b}	9.32 ± 0.09^{c}	**<0.0001**	↗
Yolk (cm^3)	10.68 ± 0.94^{a}	10.31 ± 0.78^{ab}	9.61 ± 0.99^{b}	**0.048**	↘
Egg white (cm^3)	34.24 ± 1.53	34.27 ± 1.63	35.11 ± 2.08	0.636	–
Air chamber (cm^3)	0.27 ± 0.07^{a}	0.52 ± 0.07^{b}	0.79 ± 0.17^{c}	**<0.0001**	↗
Blastoderm (cm^3)	0.27 ± 0.11	0.28 ± 0.05	0.33 ± 0.06	0.129	–

(Source : Kouame, *et al.,* 2021)

Table 4. Age of the broiler breeder and the length of egg storage: effects on the weight of the organs and body of the hatchling

Treatment	Hatchability, %	Chicken weight (g)	Residual yolk weight (g)	YFBM (g) [1]	Heart (%) [2]	Liver (%) [2]	Intestine (%)[2]	Stomach (%)[2]
Storage duration, D								
5	74.2^{a}	46.88	6.88^{b}	40.00	0.83	3.92^{a}	4.01^{a}	6.18
12	72.6^{a,b}	48.30	8.58^{a}	39.71	0.86	3.96^{a}	3.77^{a,b}	6.10
19	69.2^{b}	47.11	7.80^{a,b}	39.30	0.87	3.67^{b}	3.56^{b}	6.06
SEM	1.2	0.57	0.32	0.39	0.01	0.06	0.09	0.09
Breeder age, wk								
47	84.9^{a}	46.91	7.21^{b}	39.70	0.83	3.76^{b}	3.81	6.20
67	59.1^{b}	47.94	8.30^{a}	39.64	0.87	3.94^{a}	3.75	6.02
SEM	0.9	0.46	0.26	0.32	0.01	0.05	0.07	0.08
Storage duration * Breeder age								
5*47	86.7	46.45	6.48	39.97	0.83^{b}	3.77	4.14	6.14
5*67	61.7	47.31	7.29	40.02	0.82^{b}	4.07	3.89	6.22
12*47	86.2	47.52	7.70	39.82	0.85^{a,b}	3.98	3.83	6.33
12*67	59.0	49.08	9.47	39.61	0.86^{a,b}	3.95	3.71	5.86
19*47	81.7	46.78	7.46	39.32	0.82^{b}	3.54	3.47	6.15
19*67	56.7	47.43	8.15	39.29	0.93^{a}	3.80	3.65	5.97
SEM	1.6	0.80	0.45	0.55	0.02	0.08	0.13	0.13
P-values								
Storage duration	<0.001	0.18	0.002	0.46	0.08	<0.001	0.003	0.66
Breeder age	0.01	0.13	0.005	0.89	0.03	0.009	0.55	0.09
Storage duration x breeder age	0.78	0.85	0.44	0.98	0.02	0.10	0.26	0.12

(Source: Pipin, *et al.,* 2013)

Table 5. Effects of egg storage time and broiler breeder age, as well as how these two factors interact with posthatch performance at 35 days of age in chickens.

Treatment	Body weight (g)	ADWG[1]	Feed intake day 0 to 35 (g)	FCR[2]	Mortality day 0 to 35 (%) [3]	EPI[4]
Storage duration, D						
5	2,165	63.7	2,834[b]	1.31[b]	5.3	461[a]
12	2,187	64.3	2,993[a,b]	1.37[a,b]	4.9	449[a,b]
19	2,161	63.5	3,033[a]	1.40[a]	5.8	428[b]
SEM	11	0.3	47	0.02	0.5	8
Breeder age, wk						
47	2,163	63.6	2,898[a]	1.34	5.6	450
67	2,179	64.1	3,009[b]	1.38	5.1	442
SEM	9	0.3	38	0.02	0.4	6
Storage duration * Breeder age						
5*47	2,156	63.4	2,762	1.28	5.5	468
5*67	2,174	63.9	2,905	1.34	5.1	454
12*47	2,166	63.7	2,949	1.36	5.2	445
12*67	2,209	65.0	3,037	1.37	4.5	453
19*47	2,167	63.7	2,981	1.38	5.9	436
19*67	2,155	63.4	3,084	1.43	5.6	419
SEM	15	0.4	66	0.03	0.7	11
P-values						
Storage duration	0.18	0.18	0.001	0.008	0.48	0.02
Breeder age	0.20	0.20	0.05	0.09	0.43	0.40
Storage duration * breeder age	0.21	0.21	0.85	0.68	0.96	0.45

Activate Window

(Source: Pipin, *et al.,* 2013)

Discussion

Nataamijaya et al. (1989) namely using egg sources from broodstock that are truly superior (selected) seeds will get good results. This was also explained by Wibowo and Jafendi (1994), who stated that eggs were more influenced by chickens or broodstock as a source of seeds and other factors related to hatchery management. (Idayanti, 2003) which states that eggs stored at low temperatures or cold temperatures will minimize water evaporation, carbon dioxide evaporation and microbial activity in the eggs. Gunawan (2001), which states that to reduce failure in hatching chicken eggs, selection of hatching eggs needs to be done. Egg fertility is obtained after the process of fertilization occurs, namely the fusion of sperm cells and egg cells. The Research Institute for Superior Livestock and Forage Animal Feed Sembawa (2014) argues that eggs from artificial mating (AI) will provide a high level of hatchability even though the fertility rate is low. Sudjarwo (2014) states that eggs stored for more than 10 days will produce low hatchability, because inside the egg there is a chalaza layer as a separator between the yolk and albumen which is cut off, so it becomes kopyor and embryo development will be disrupted, therefore the hatchability produced will be low.

Same opinion put forward by (Hartono and Isman, 2012), which states that the part of the egg that plays an important role in the hatching process is the chalaza. Chalaza is the white part of the egg which has a vital role as a binding agent for the yolk. If the chalaza is cut off, the embryo inside the egg will not develop optimally and normally. Conversely, if the temperature is low during the hatching process, the incubation period will be longer and the embryo will die, as well as the higher the temperature during the hatching process, the incubation period will be faster. Soesanto (2002), states that hatching time is strongly influenced by the environment in the incubator, if the temperature is normal during the hatching process, it will provide the right hatching time. According to Burke (1992) states that if the temperature is normal during the hatching process, it will provide the right hatching time (eg: quail eggs 17 days incubation period, chicken 21 days, ducks 28 days) and produce a high level of hatchability, because the process embryonic development can run normally as a result of its vital organs being able to form and develop normally. Rasyaf (1990) which states that increasing the age of hatching eggs also results in more evaporation of liquid and gas from inside the eggs, eggs that are Tthe longer it is stored, the liquid will be lost which has the function of dissolving the nutrients in the egg, where these substances are used for food for the embryo while it is in the egg. Tullet

and Burton (1982), shrinkage of egg weight is caused by the influence of temperature stored or during the hatching period which can affect the quality of the chicks produced. Rahayu (2005) which states that children are produced from hatching eggs is strongly influenced by the age of the eggs because eggs contain nutrients such as vitamins, minerals and water needed for growth during incubation. These nutrients also serve as a food reserve for some time after the chicks hatch. Sudaryani (2006), which stated that the longer it is stored can reduce the quality of eggs such as reduced DOC weight. Setiawan (2010), states that embryonic death can occur due to inappropriate hatching procedures such as: incubator temperature is too high or too low, egg storage is too long, eggs not playing. An egg that is not rotated or turned over due to negligence or a power failure will obviously affect the position of the embryo.

As a result, the embryo cannot grow normally and eventually dies. Yoyo (2009), states that embryo death can occur because the parent feed has nutritional deficiencies such as vitamins and minerals, so that metabolism and embryo development are not optimal. To overcome this, it is necessary to add vitamin and mineral supplements to the main ration.

Conclusion

From the results of the research conducted, it can be concluded that the storage time is 9 days (P5) showed hatchability, high fertility and lowest embryo mortality. Need research on the other animal for future research.

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