MendelNet

Conference Brno 2021

Editors:

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Proceedings of 28th
International PhD Students Conference

10 November 2021, Brno, Czech Republic

Mendel University in Brno
Faculty of AgriSciences

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The MendelNet 2021 conference would not have been possible without the generous support of The Special Fund for a Specific University Research according to the Act on the Support of Research, Experimental Development and Innovations and the **support of**:

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Profi Press s.r.o.

Research Institute of Brewing and Malting, Plc.

All contributions of the present volume were peer-reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.

ISBN 978-80-7509-821-4

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PREFACE

Each year, the editors of the volume you are about to read are tasked with the responsibility of putting a coherent form to the proceedings from MendelNet, the international PhD Students Conference of the Faculty of AgriSciences of Mendel University in Brno.

The event which reached, this year, on November 10, 2021, its 28th edition, is traditionally aimed at both under and postgraduate students from the Czech Republic, Europe and beyond, and proudly welcomes the participants of various professional and cultural backgrounds. And while this time the people could not gather on-site due to globally-imposed covid-19 restrictions, the conference swiftly transformed itself into a virtual and fascinating beehive of results, opinions and brand new research paths and ideas.

Here in Brno, under the spell of great genetician G. J. Mendel and the guidance of skilled senior researchers and supervisors, students can introduce, defend and discuss their scientific results while those who do not feel confident enough to present and pen their paper in English are invited to join as spectators and follow-up discussion participants.

The best submissions are, after rigorous peer-review process, collected here and range from plant and animal production to fisheries and hydrobiology to wildlife research while agroecology and rural development, food technology, plant and animal biology, techniques and technology and applied chemistry and biochemistry also belong to the core areas being investigated.

The collection as varied and huge as this can succeed only as a team effort, both on authors' and editors' side, so we would like to express our thanks and gratitude to all committees and reviewers both for their outstanding work and invaluable comments and advice.

The Editors

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Effect of storage and preincubation on hatching egg quality and hatchability in meat type chicken

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Abstract: The aim of the study was to evaluate the effect of hatching eggs storage and their preincubation on eggs quality, hatchability and one-day old chick weight in young meat-type ROSS 308 parent stock, 31 weeks of age. Total of 1920 hatching eggs were used in this experiment for incubation, for egg quality analysis. Eggs were divided into three groups and stored for 21 days. Group P0 was not treated by preincubation. Group P1 contained hatching eggs which were preincubated once at the fifth of storage. Group P2 contained hatching eggs which were preincubated at days 5 and 10 during storage period. Egg quality was analysed for fresh eggs too. Long storage and repeated preincubation decreased both egg weight and yolk dry matter ($P < 0.05$). After application of preincubation, the degree of embryonic development significantly increased ($P < 0.05$). Preincubation and 21day storage of hatching eggs had no effect on hatchability and embryonic mortality. The weight of day-old chicks significantly decreased in chicks hatched form eggs twice treaded by preincubation.

Key Words: embryonic development, embryonic stage, broiler, quality of hatching eggs

INTRODUCTION

Long term storage has a negative effect on hatchability of chickens, increases embryonic mortality, especially early embryonic mortality (Fasenko et al. 2001), reduces the quality of one day-old chicks and their viability. Negative effects of long-term storage include increased hatching time (Tona et al. 2003), increased mortality after hatching (Yassin et al. 2008), impaired growth after hatching, which is reflected in reduced growth and quality during and at the end of fattening (Tona et al. 2004). The reduction in hatchability is around 0.2% per day up to 7 days of storage, after 7 days of storage the hatchability decreases by 0.5% (Yassin et al. 2008).

Storage temperatures must correspond to the so-called physiological zero, ie the temperature at which the embryo's ability to continue embryonic development is almost stopped (Funk and Biellier 1944). The way, to eliminate these negative consequences of long-term storage at least partially is the application of modern biotechnological methods, such as the method of preincubation hatching eggs. The preincubation of hatching eggs is carried out once or repeatedly during storage, the first preincubation is applied until the 7th storage, most often on the 5th day of storage. The principle of this method is to increase the temperature above physiological zero, preferably with the help of the Re-Store device (Fasenko 2001). Preincubation can also have a negative effect on the hatchability of chickens if the application of elevated temperature is longer than optimum and thus exceeds the stage of embryonic development 13 developmental stage according to the methodology of Eyal-Giladi and Kochav (1976), when the hypoblast is completely formed, in the next phase already forms the basis of the primitive strip (Fasenko et al. 2001, Tesařová 2018). When applying preincubation, it is therefore necessary to determine the stage of embryonic development before and after its application, so that the 13 developmental stage is not exceeded (Fasenko et al. 2001). Although preincubation has a positive effect on the hatchability of chickens with the correct application of preincubation, ie not exceeding 13 degrees of embryonic development according to the methodology of Eyal-Giladi and Kochav (1976), in some cases this positive effect is lost and hatchability is reduced. This negative effect occurred in long-term stored eggs that came from an older parent flock at 45 weeks of age. Hatching eggs which

were not preincubated before and during long-term storage showed 1.1% higher hatchability than eggs treated before and during long-term storage by preheating. The same parental flock at the age of 30 weeks responded to the application of preincubation before and during long-term storage by increasing the hatchability by 3.11% (Tesařová 2018). Reijrink et al. (2009) also reported that a parent flock of the Cobb 500 hybrid combination at 61 weeks of age showed that preincubation had a negative effect on stored eggs for 12 days, reducing hatching by 6.2%. On the contrary, a young parent flock at the age of 28 weeks showed a positive reaction to preincubation and subsequently to hatchability. Eggs stored 11 days after preheating were increased by 5.3% compared to the unpreincubated control.

The reduction in hatchability can be caused by cell death in a few processes, that take place inside the egg during long-term storage. These negative consequences can be caused by a change in the weight of the yolk and protein, thinning of the vitreous membrane of the yolk, weight loss of the egg, enlargement of the air chamber, and a rapid and high increase in pH of the white and yolk (Scott and Silversides 2000). Protein has an average value of 7.6 in fresh eggs, during long-term storage it can reach up to 9 (Lapão et al. 1999). During storage, the pH of the yolk also changes, although not as significantly as in the case of egg white. The pH value after laying in the yolk is approximately 6, it can reach values up to 6.8 pH (Kirunda and McKee 2000). The pH value of the yolk is affected not only by the storage time, but also by the storage temperature, the higher the temperature, the faster the pH rises (Jin et al. 2011). Increasing the weight of the yolk due to the migration of water from the protein further causes a thinning of the yolk vitreous membrane and a loss of elasticity due to which increases its susceptibility to mechanical damage Moran (1936).

MATERIAL AND METHODS

In a total 1920 hatching eggs of meat type hybrid ROSS 308 at the age 31 weeks were used in this study. Thirty fresh eggs (control group) were used for their quality measurements at the day, when they arrived to the hatchery. The rest of these eggs was divided into three groups and these eggs were stored 21 days prior incubation.

Group P0 was not treated by preincubation. Group P1 contained hatching eggs which were preincubated once at the fifth of storage. Group P2 contained hatching eggs which were preincubated at days 5 and 10 during storage period.

Hatching eggs were preincubated according to the standard Petersime program. This program heated hatching eggs to 95 °F and, after reaching this temperature, heated the hatching eggs for one hour. The temperature of the hatching eggs was monitored with Ovoscan. The storage temperature was 14 °C, humidity 70% and during storage the eggs were turned at hourly intervals at an angle of 90 °.

In each group eggs were sat in 11 trays, 60 eggs per 10 trays and one tray with 30 eggs. These thirty eggs in each group were used for egg quality measurements at 21st day of storage.

At day 7 of incubation, all hatching eggs were candled, and clear eggs were opened to macroscopically determine embryonic mortality and fertility; blastoderms and blastodics were differentiated. On hatching day, live hatched chicks were counted per basket. All unhatched eggs were opened to determine the stage of embryo mortality; early stage embryonic mortality to 9d of incubation (black eye visible, embryo without feathers), middle stage embryonic mortality 10-17d of incubation (small embryo with feathers), late stage embryonic mortality 18–21d (full grown embryo with yolk out or full grown embryo dead or alive with yolk subtracted). Because fertility was determined macroscopically, it is possible that an embryo that died during storage was classified as an infertile egg, therefore hatchability and embryonic mortality were calculated as a percentage of set eggs, where egg origin was the same for all treatments. One hundred randomly selected chicks per treatment were weighed.

Under egg quality following parameters were evaluated: egg weight, yolk weight, shell weight, shell thickness, egg shape index, eggshell strength, Haugh units, pH of yolk and white and dry matter of yolk and white. Furthermore, the degree of embryonic development of the eggs was evaluated.

Blastoderm from hatching eggs were isolated and subsequently determined according to the methodology for determining the degree of embryonic development Eyal-Giladi and Kochav (1976).

Observed characteristics were expressed by means and variability by standard error and coefficient of variability. The results for egg quality and incubation variables were analysed by ANOVA with a general linear model procedure (Unistat 5.1 software, UNISTAT Ltd, ENGLAND). Mean differences were tested using the LSD test.

RESULTS AND DISCUSION

The results show (Table1) that during long-term storage, the pH of the albumen increased and the quality of the white expesed by Haugh units decreases ($P < 0.05$). However preincubation did not have effect on white pH.

Table 1 Egg quality in fresh and 21 days stored eggs and stage of embryonic development

Monitored parameters	Experimental groups											
	P0 ($\bar{x}$)	SE	v_x	P1 $\bar{x}$	SE	v_x	P2 $\bar{x}$	SE	v_x	Control $\bar{x}$	SE	v_x
Weight of eggs	56.0^{b}	0.32	0.03	55.3^{ab}	0.48	0.05	54.9^{a}	0.51	0.05	57.8^{c}	0.72	0.05
Weight of yolk	16.5^{a}	0.17	0.05	16.7^{a}	0.20	0.06	16.8^{a}	0.23	0.07	16.4^{a}	0.20	0.05
Yolk dry matter	49.00^{b}	0.21	0.01	48.35^{b}	0.27	0.02	45.32^{a}	0.99	0.07	50.27^{c}	0.12	0.01
White dry matter	13.3^{a}	0.55	0.13	13.2^{a}	0.55	0.13	12.47^{a}	0.62	0.15	12.67^{a}	0.24	0.06
pH of yolk	6.29^{a}	0.03	0.02	6.5^{c}	0.05	0.04	6.38^{b}	0.04	0.03	6.3^{ab}	0.05	0.04
pH of white	$9{,}1^{b}$	0.01	0.01	9.1^{b}	0.01	0.01	9.1^{b}	0.02	0.01	9.06^{a}	0.03	0.01
Eggshell strength	35.2^{b}	0.74	0.11	35.2^{b}	0.83	0.12	34.3^{ab}	1.05	0.15	32.5^{a}	1.29	0.17
Eggshell thickness	0.5^{a}	0.01	0.06	0.5^{b}	0.01	0.00	0.5^{b}	0.01	0.05	0.5^{b}	0.01	0.05
Eggshell weight	5.4^{a}	0.19	0.18	5.29^{a}	0.09	0.09	5.1^{a}	0.07	0.07	5.1^{a}	0.09	0.08
Egg shape index	80.2^{a}	0.44	0.03	79.9^{ab}	0.38	0.02	80.1^{b}	0.59	0.04	79.0^{a}	0.68	0.04
HU	80.5^{a}	0.91	0.06	83.18^{b}	1.05	0.07	81.7^{ab}	0.96	0.06	96.8^{c}	0.77	0.03
Stage of embryonic development	10^{a}	0	0	10.3^{b}	0.09	0.05	11.5^{c}	0.19	0.07	10^{a}	0	0

Legend: SE – standard error of the mean, v_x – coefficient of variation, a,b,c – means in the same row designated by different letters are significantly different ($P < 0.05$), P0 is the mean for the group that was stored, P1 is the mean for the group that was stored and preincubated (1x), P2 is the mean for the group that was stored and preincubated (2x)

These data are consistent with the results of Lapão et al. (1999), which state that overall, albumen pH increased from 8.20 to 9.15 in eggs stored between 0 and 8 day, but most of this increase occurred during the first 4 d of storage. These results are confirmed by the results of Tona et al. (2004) who also report a reduction in HU after long-term storage.

Alsobayel et al. (2017) report that long-term storage (15 days) increased the yolk pH from 6.10 to 6.36. The results in this experiment show that the yolk pH of the control group was 6.3 and of P0 6.29, without significant difference. Preincubation significantly increased yolk pH in groups P1 and P2 compared with P0 ($P < 0.05$).

The weight of the eggs decreased after the application of long-term storage and pre-incubation ($P < 0.05$), and these results agree with the results of Khan et al. (2014), who report that the weight of hatching eggs from RIR decreased after 9 days of storage from 44.7 to 43.63 g.

In the yolk, there was a slight increase in weight in groups P0, P1 and P2 compared to the control group. Khan et al. (2014) report an increase in yolk weight after 9 days of storage from 15.90 to 17.27 g.

Due to the migration of water from the white to the yolk during long-term storage, the vitelline membrane is mechanically stretched and its elasticity is reduced (Moran 1936). Due to the increase in water in the yolk, the dry matter content of the yolk decreases and the dry matter in the barrel increases. In this experiment, the dry matter of the white increased from 9.06% to 9.01% and the dry matter of the yolk decreased from 50.27% to 49.0% for group P0, 48.35% for P1 and 45.32% for P2 ($P < 0.05$).

After preincubation, the degree of embryonic development shifted in both groups ($P < 0.05$). Similar data were concluded by Tesařová (2018), who determined stage of embryonic development

in hybrid meat type ROSS 308 at the age of parent flocks 30, 45 and 58 weeks. Most fertilized eggs were stage X, but stage XI eggs were observed in all three groups.

Table 2 Hatchability, embryonic mortality and weight day-old chick

Monitored parameters	Experimental groups								
	P0 $\bar{x}$	SE	v_x	P1 $\bar{x}$	SE	v_x	P2 $\bar{x}$	SE	v_x
Hatchability	88.8[a]	1.91	0.07	87.1[a]	1.12	0.04	87.2[a]	1.08	0.04
Early embryonic mortality	7.3[a]	1.4	0.6	7.7[a]	0.7	0.3	7.4[a]	1.11	0.47
Middle embryonic mortality	1.0[a]	0.37	1.16	1.5[a]	0.46	0.96	1.0[a]	0.45	1.4
Late embryonic mortality	3.2[a]	0.78	0,77	3.7[a]	0.89	0.75	4.4[a]	0.44	0.32
Weight of day-old chick	39.1[b]	0.22	0.06	38.9[ab]	0.24	0.06	38.6[a]	0.24	0.06

Legend: SE – standard error of the mean, v_x – coefficient of variation, a,b – means in the same row designated by different letters are significantly different (P <0.05), (P <0.05), P0 is the mean for the group that was stored, P1 is the mean for the group that was stored and preincubated (1x), P2 is the mean for the group that was stored and preincubated (2x)

Preincubation (Table 2) had no significant effect on the hatchability of chickens compared to the non-preincubated group. The same result was achieved by Tesařová (2018) in chickens at the age of the parent flock of 45 weeks.

The weight of day-old chicks decreased in both groups to which preincubation was applied. These results correspons with Tona et al. (2004), who also reported reduced chicken weight after long-term storage. The weight reduction of day-old chicks is also reported by Khan et al. (2014). In their experiment, the weight was reduced from 30.46 g to 29.89 g after 9d storage hatching eggs from RIR (rhode islands red).

CONCLUSION

Long storage and repeated preincubation decreased both egg weight and yolk dry matter (P <0.05). After application of preincubation, the degree of embryonic development significantly increased (P <0.05). Preincubation and 21day storage of hatching eggs had no effect on hatchability and embryonic mortality. The weight of day-old chicks significantly decreased in chicks hatched form eggs twice treaded by preincubation.

ACKNOWLEDGEMENTS

The research was financially supported by the grant no. AF-IGA2021-IP027.

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Name of publication:	MendelNet 2021 *Proceedings of 28th International PhD Students Conference*
Editors:	Assoc. Prof. Ing. Radim Cerkal, Ph.D. Ing. Natálie Březinová Belcredi, Ph.D. Ing. Lenka Prokešová
Publisher:	Mendel University in Brno Zemědělská 1665/1 613 00 Brno Czech Republic
Year of publication:	2021
Number of pages:	492
ISBN:	978-80-7509-821-4

Contributions are published in original version, without any language correction.