



MendelNet

Conference Brno 2021



Editors:

Radim Cerkal

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Lenka Prokešová

Proceedings of 28th
International PhD Students Conference

10 November 2021, Brno, Czech Republic

Mendel University in Brno
Faculty of AgriSciences



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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

TABLE OF CONTENTS

PLANT PRODUCTION

Comparing of observed and simulated field crop production in HERMES2Go model at Hněvčeves locality BOHUSLAV J., KERSEBAUM K.C., MADARAS M., HLAVINKA P., TRNKA M., ZALUD Z.	13
Modelling the onset of phenological phases of spring barley (<i>Hordeum vulgare</i> L.) DIZKOVA P., BARTOSOVA L., HAJKOVA L., BALEK J., BLAHOVA M., BOHUSLAV J., POHANKOVA E., TRNKA M., ZALUD Z.	19
The effect of milk thistle cultivation technology [<i>Silybum marianum</i> (L.) Gaertner] on the yield and contained compounds FOJTIKOVA L., BRADACOVA M., KUDLACKOVA B., BJELKOVA M., PLUHACKOVA H.	25
Yield formation parameters of winter wheat under two CO ₂ levels in water sufficient and depleted environment HLAVACOVA M., KLEM K., VESELA B., FINDUROVA H., HLAVINKA P., SMUTNA P., HORAKOVA V., SKARPA P., TRNKA M.	31
Use of unmanned aerial remote sensing for in-season diagnosis of winter wheat nitrogen status HORNIACEK I., LUKAS V., NEUDERT L., DUFFKOVA R., MEZERA J., SMUTNY V.	37
Seed vigour effected by total polyphenols content JOVANOVIC I., EDISON ALBA-MEJIA J., PSOTA V., STREDA T.	43
A variety of transpiration in the young spruce stands with different thinning management KYSELOVA I., SZATNIEWSKA J., VAGNER L., KREJZA J., PAVELKA M.	49
Estimation of winter wheat nitrogen status and prediction of crop yield by satellite and proximal sensing MEZERA J., LUKAS V., ELBL J., NEUDERT L., HORNIACEK I., SMUTNY V.	55
Influence of vermicompost on growth parameters and content of chlorophylls in maize during vegetation NEUPAUER J., KOVACIK P.	61
Interactive effects of adaptation technology, based on no-till sowing into the mulch of cover crop residues, and nitrogen nutrition on photosynthetic performance of maize under drought stress OPOKU E., HOLUB P., FINDUROVA H., VESELA B., KLEM K.	67
A comparison of the efficiency of pheromone lures on the <i>Cydia pomonella</i> (codling moth) PRAZANOVA Z., SEFROVA H.	73
Evaluation of nutritional potential of selected sorghum varieties in relation to different types of soil localities RIHACEK M., NOVOTNY J., ZALESAKOVA D., HORAKOVA L., MRKVICOVA E., PAVLATA L., STASTNIK O., SMUTNY V., RABEK M.	78

The effect of biochar co-application with soil prebiotic on biomass production and soil basal respiration	
RUZICKA D., POLACH V., ZAHORA J.	83
Effect of elevated CO ₂ concentration and nitrogen nutrition on mais response to short-term high temperature and drought stress	
SIMOR J., KLEM K.	88
Estimation of winter wheat yield using machine learning from airborne hyperspectral data	
SVIK M., PIKL M., JANOUTOVA R., VESELA B., SLEZAK L., KLEM K., HOMOLOVA L.	94
The effect of different technical details of drip irrigation on fruit yield and annual increments of "Gala" apple	
VASTIK L., MASAN V., BURG P., ZEMANEK P., HIC P.	100

ANIMAL PRODUCTION

Different selenium sources in medium-slow growing broiler chicken's diets and their influence on blood biochemical and performance parameters	
HORAKOVA L., NOVOTNY J., ZALESAKOVA D., RIHACEK M., ROZTOCILOVA A., STASTNIK O., MRKVICOVA E., PAVLATA L.	107
The influence of organic and inorganic selenium sources on the metabolism of broiler chickens	
HORAKOVA L., NOVOTNY J., ZALESAKOVA D., RIHACEK M., STASTNIK O., MRKVICOVA E., PAVLATA L.	113
The effect of stage and number of lactations on the incidence of milking success when using Automatic Milking Systems	
JENIK D., FALTA D., KOPEC T., VECERA M., LATEGAN F., CHLADEK G.	118
Evaluation of reproductive parameters at a farm specializing in breeding of Czech Fleckvieh dairy cows	
KOCIANOVA K., FILIPCIK R., RECKOVA Z., PESAN V.	122
Determination of the effectiveness of disinfectants containing organic acids for bovine footbaths	
LANGOVA L., MACHACEK M., HAVLICEK Z., NEMCOVA P., NOVOTNA I.	126
The effect of breed on body indices in draft horses in Czech Republic	
MATUSKOVA A., COUDKOVA V., FILIPCIK R., MARSALEK M.	131
Methods for assessing the health of the limbs and their relationship to the duration of treatment for footrot: a pilot study	
NEMCOVA P., HAVLICEK Z., LANGOVA L., NOVOTNA I.	137
The influence of different feed particle size in broiler diets on the performance parameters and digestive viscosity	
NOVOTNY J., HORAKOVA L., ZALESAKOVA D., RIHACEK M., KUMBAR V., STASTNIK O., PAVLATA L.	142

The effect of cumin (<i>Carum carvi</i> L.) on broiler chickens performance parameters NOVOTNY J., HORAKOVA L., ZALESAKOVA D., RIHACEK M., MRKVICOVA E., PLUHACKOVA H., STASTNIK O., PAVLATA L.	148
Determination of optimal insemination time in sheep by assessing cervical mucus arborization PESAN V., HOSEK M., FILIPCIK R., SOUSKOVA K., PESANOVA TESAROVA M.	152
Effect of storage and preincubation on hatching egg quality and hatchability in meat type chicken PESANOVA TESAROVA M., LICHOVNIKOVA M., FOLTYN M.	158
Evaluation of Holstein cows originated from embryo transfer POPELKOVA M., FILIPCIK R., KOPEC T., RECKOVA Z.	163
Condition of honeybee colonies overwintered with winter stores enriched by extracts of polypore mycelia PROUZA J., MUSILA J., PRIDAL A.	166
The effect of cumin (<i>Carum carvi</i> L.) on medium-slow growing chickens performance parameters RIHACEK M., NOVOTNY J., HORAKOVA L., ZALESAKOVA D., ROZTOCILOVA A., MRKVICOVA E., STASTNIK O., PAVLATA L.	171
The influence of different variations of selenium sources in diets on blood biochemical parameters in fast growing broiler chickens ZALESAKOVA D., NOVOTNY J., RIHACEK M., HORAKOVA L., ROZTOCILOVA A., STASTNIK O., MRKVICOVA E., PAVLATA L.	176
Blood biochemical parameters in the evaluation of chicken nutrition during the starter feed period ZALESAKOVA D., RIHACEK M., NOVOTNY J., HORAKOVA L., STASTNIK O., MRKVICOVA E., PAVLATA L.	181
The effect of housing technology on the milk performance of Holstein dairy cows in selected breeding ZAPLETALOVA L., VECERA M., CHLADEK G., POPELKOVA M., LANGER R.	187

FISHERIES AND HYDROBIOLOGY

Is oral application of plastic particles able to provoke the oxidative stress and alter expression of an immunity related genes in rainbow trout? HOLLEROVA A., HODKOVICOVA N., BLAHOVA J., FALDYNA M., MEDKOVA D., MARES J., SVOBODOVA Z.	193
Selected biochemical parameters of two common carp (<i>Cyprinus carpio</i>) breeds infected with koi herpesvirus MACHAT R., LEVA L., POJEZDAL L., FALDYNA M.	197
Effects of pesticides on catfish (<i>Silurus glanis</i>) embryos MEDKOVA D., LAKDAWALA P., DOUBKOVA V., BLAHOVA J., HOLLEROVA A., WEISEROVA Z., HODKOVICOVA N., SVOBODOVA Z., MARES J.	200

Toxicity tests on <i>Daphnia magna</i> MELEZINKOVA P., POSTULKOVA E., KOPP R.	203
Rotifers and microcrustaceans communities in natural and restored peatlands PFEIFER L., SORF M.	208
Use of peas in fish nutrition ZEZULA F., MARES J., MALY O., SORF M., PFEIFER L.	213

WILDLIFE RESEARCH

Contribution to the faunistic research of beetles (Insecta: Coleoptera) in Natural Monument Růžový kopec near Mikulov KOPR D.	219
Importance of cereals for population dynamics of common voles (<i>Microtus arvalis</i>) – a case study from Moravia (Czech Republic) SKOPALOVA G., SIPOS J., SUCHOMEL J.	224
Influence of different forage mixtures treated selenium and zinc on pollinators SODOMOVA K., HYBL M., SIPOS J.	229

AGROECOLOGY AND RURAL DEVELOPMENT

Integrated national-scale assessment of climate change impacts on agriculture: the case of the Czech Republic ARBELAEZ GAVIRIA J., BOERE E., HAVLIK P., TRNKA M.	236
Analysis of small forest catchments evapotranspiration determined by precipitation/runoff measurements, remote sensing model DisALEXI and water balance model SoilClim GHISI T., FISCHER M., OULEHLE F., ZALUD Z., TRNKA M.	242
Analysis of awareness of the implementation of agricultural production in Czech Republic LANGER R., DRYŠLOVA T.	248
Historical and contemporary endangered wetland species of the southeastern part of the Bohemian-Moravian Highlands OULEHLA J., JIROUSEK M., STASTNA M.	252
Variation of glomalin content in the Czech soils and the relationships to the chemical soil characteristics and climatic regions POLACH V., PATRA S., KAREL K.	258
Determining the phytotoxicity of rubber granulate from waste tires SOURKOVA M., ADAMCOVA D.	263
Optimization of ATS system for pollutants removing TARBAJOVA V., CHALOUPSKY P., HUSKA D.	268

FOOD TECHNOLOGY

Development of 3D printing in food processing BAUER J., JANOUŠ S., BENO F., SEVČÍK R.	275
Use of leftover bread for beer production DYMCHENKO A., GERSL M., GREGOR T.	281
Reduction of weight loss after defrosting of meat using a gelatin-based coating MARTINEK J., GAL R., MOKREJS P., SUCHACKOVÁ K.	286
Quality of malt made from current and historical malting barley varieties NEMETHOVÁ M., PSOTA V., GREGOR T.	292
Encapsulation of fortifying ingredients in colloidal emulsions of lecithin ONDROUSKOVÁ K., LAPČIKOVÁ B., LAPČÍK L., SZYK WARSZYŃSKA L., BURESOVÁ R.	296
Quality of superworm (<i>Zophobas morio</i>) fats determined by Raman spectroscopy PECOVÁ M., PLEVA B., POSPIECH M.	302
Effects of a preparation based on a functional collagen polymer on the skin in the periorbital area PROKOPOVÁ A., PAVLACKOVÁ J., GAL R., MOKREJS P.	307
A comparative study on the selected quality properties of frankfurters with using chicken breast meat SLOVACEK J., GROSSOVÁ L., SNUPIKOVÁ N., PIECHOWICZOVÁ M., STASTNÍK O., JUZL M.	313
Possibilities of use and quality parameters of beaver canned meat (<i>Castor fiber</i> L.) SLOVACEK J., JUZL M., POPELKOVA V., PIECHOWICZOVÁ M., DRIMAJ J., MIKULKA O.	318
Quality of beer made from bakery leftovers SNUPIKOVÁ N., GROSSOVÁ L., HRIVNÁ L., GREGOR T., KOURILOVÁ V., DUFKOVÁ R., JUZL M.	324

PLANT BIOLOGY

Effects of intermittent-direct-electric-current (IDC) on growth and content on photosynthetic pigments in hemp (<i>Cannabis sativa</i> L.) BALOG N., VYHNANEK T., KALOUSEK P., SCHREIBER P.	331
Method for simultaneous detection of <i>Phytophthora infestans</i> proteins and DNA in <i>Solanum tuberosum</i> samples BERKA M., BERKOVÁ V., KOPECKÁ R., GREPLOVÁ M.	337
Characterization of the potential biological control <i>Acremonium alternatum</i> using omics approaches BERKOVÁ V., MENŠIKOVÁ S., AUER S.	342

Atmospheric CO ₂ concentration, light intensity, and nitrogen nutrition affect spring barley response to drought and heat stress FINDUROVA H., VESELA B., OPOKU E., KLEM K.	348
Determination of chlorophyll content, RWC and LDMC in leaves of sorghum and maize during two different phenological stages in the field conditions FRANTOVA N., RABEK M., ELZNER P., SMUTNY V.	354
Transcript levels of <i>VRN1</i> , <i>PPD-D1</i> , <i>PPD-B1</i> and <i>PPD-A1</i> genes during different developmental stages of winter wheat FRANTOVA N., SMUTNA P., HOLKOVA L.	360
Auxin or sugar? Which has higher impact on bud outgrowth regulation? KUCSERA A., BALLA J., PROCHAZKA S.	366
Identification of powdery mildew (<i>Erysiphales</i>) species on ornamental perennial plants (<i>Asteraceae</i>) in the gardens of Mendel University in Brno MICHUTOVA M., POKORNY R., SAFRANKOVA I.	371
Short-term application of elevated temperature and drought influences the isotopic composition of winter wheat grains PERNICOVA N., URBAN O., CASLAVSKY J., KLEM K., TRNKA M.	377
Methodology of phenotypes selection of hemp (<i>Cannabis sativa</i> L.) for secondary metabolite production SCHREIBER P., BALOG N.	383

ANIMAL BIOLOGY

DNA barcoding and metabarcoding in forensic entomology: casuistic and future challenges OLEKSAKOVA T., KLIMESOVA V., SULAKOVA H.	390
Stallion semen cooling using different types of extenders SOUSKOVA K., RECKOVA Z., KOPEC T., BRUDNAKOVA M., FILIPCIK R.	394
Associations of <i>SOST</i> and <i>TNFSF11</i> genes polymorphisms with bone parameters in broilers STEINEROVA M., HORECKY C., KNOLL A., NEDOMOVA S., PAVLIK A.	399

TECHNIQUES AND TECHNOLOGY

Comparison of fatigue behaviour of AlSi10Mg CT samples prepared by casting and by additive technologies DVORAKOVA J., DVORAK K., CERNY M.	406
Alternative mechanical pre-treatment methods of hot-dip galvanising surface to increase of the organic coatings adhesion LOZRT J., VOTAVA J., SMAK R.	412

Comparison of stress action of real specimens and computer model during tensile testing PERNICA J., SUSTR M., DOSTAL P., VODAL M., SAROCKY R., BRABEC M., ZACAL J.	418
Hyperspectral imaging LED and incandescent light source comparison for food quality inspection ROUS R., ONDROUSEK V., JUZL M.	424
The evaluation of selected mechanical and physical properties of pelletized compost SINKOVA A., BURG P., MASAN V., CIZKOVA A.	430
Stability of intermetallic phases in the heat affected zone depending on shielding gases SMAK R., VOTAVA J., LOZRT J., POLCAR A.	436
Mathematical models for temperature-dependent viscosity of FAME and diesel blends TROST D., POLCAR A., FAJMAN M., VOTAVA J., CUPERA J., KUMBAR V.	442
The evaluation of lawn quality cut performed by a robot lawn mower VASTIK L., MASAN V., BURG P., ZEMANEK P.	448

APPLIED CHEMISTRY AND BIOCHEMISTRY

Exploring the pH-triggerable structure of siRNA-carrying liposomal nanoparticles as tools for treatment of hepatitis B KRATOCHVIL Z., DO T.	454
Pesticides and long-term denitrification conditions PANIKOVA K., BILKOVA Z., MALA J.	458
Identification of volatile compounds produced by <i>Laetiporus sulphureus</i> using OSMAC cultivation strategy SCHLOSSEROVA N., BLAHUTOVA A., VANICKOVA L.P.	464
Cross-linked-Pd0 polyethyleneimine catalyst for bioorthogonal chemistry TAKACSOVA P., PEKARIK V.	469
Molecularly imprinted polymers as a recognition element for the determination of disease markers VODOVA M., VLCNOVSKA M., BEZDEKOVA J., VACULOVICOVA M.	475
Copper and zinc in dogs: impact of sex, age, and diet on serum levels ZENTRICOVA V., PECHOVA A.	480

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 from eggs twice treated 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 DISCUSSION

The results show (Table1) that during long-term storage, the pH of the albumen increased and the quality of the white expressed 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 corresponds 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 from eggs twice treated by preincubation.

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