SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number:15224
STSM title: Effect of perch arrangements in furnished cages on welfare parameters, behavior of laying hens, egg quality and KBD
STSM start and end date: 08/04/2019 to 19/04/2019
Grantee name: Anna Dedousi

PURPOSE OF THE STSM:

With regard to the type of housing systems that are currently applied in Greece for laying hens, approximately 37,3% of the enterprises follow the conventional rearing system (in enriched cages) while the remaining 62.7%, the alternative systems (28.1% as barns, 30.9% as free range and 3.7% as organic). The findings of previous STSM carried out in Greece in collaboration of the Faculty of Agriculture of the University of Novi Sad and the Veterinary Research Institute of Hellenic Agricultural Organization – Demeter, confirmed the prevalence of keel bone damage in three different production systems of laying hens in Greece for the first time. Since then this multifactorial welfare problem was unknown not only to the scientific and professional community but to the producers as well. Further investigation is necessary in order to determine specific risk factors of KBD, its association with the egg quality traits and strategies for reducing the occurrence and severity of this serious disorder.
The aim of this STSM was to foster the collaboration between home and host Institutions by continuing our research on keel bone damage based on the previous STSM findings. Additional goals were my training on palpation technique as a method for the assessment of Keel bone damage by Professor Dr. Đukić Stojčić as well as my engangement on the methods that are currently used for the assessment of egg quality characteristics of laying hens. Professor Dr. Đukić Stojčić's long term scientific contribution to egg quality studies as long as the fully equipped laboratory she has in her department in the University of Novi Sad were ideal for the accomplishment of this purpose.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

During my staying at the Faculty of Agriculture at the University of Novi Sad we visited three big laying hens' farms with different production systems (enriched cages, aviary, and organics). At the first farm named "Rebra Commerce" we made palpation on layers at three different phases of production cycle 100 birds/phase: a) At the beginning of production cycle, presented hybrid was Hyline Brown, 38 weeks of age b) at the middle of production cycle, presented hybrid was Hyline Silver, 56 weeks of age and c) at the end of production cycle, presented hybrid was Hyline Brown, 76 weeks of age. All birds were housed in fully equipped enriched cages. At the second farm named "Animal Commerce" presented hybrid was Lohman Brown and laying hens were housed in two different production systems: enriched cages and aviary. The aviary system was very new and the first of its kind in Serbia. Palpation was performed in birds that were at the beginning and at the middle of production cycle (36wk for the aviary system and 43wk for the enriched cages). One hundred (100) hens from each housing system were palpated. In enriched colony systems the housing equipment was the Eurovent EU and the Eurovent 2240-EU, Big Dutchman. At the aviary system the housing equipment was NATURA-Nova Twin, Big Dutchman. Finally the third farm named "Organska Jaja" was an organic one. Three thousand (3,000) laying hens of the hybrid Tetra SL were located in wooden houses with floor mats and nests of natural organic material and hanging feed and water equipment. Birds had permanent access to organic

pasture during day that allowed a maximum of 580 cubic meters of hectare of land, whereas they were housed indoors during night. Fifty (50) hens in the middle of production cycle were palpated for KBD.
In all three farms, palpation was performed by running fingers alongside and over the keel bone. Each hen was held gently by one person, and another person examined and palpated the keel bone.The existence of KBD was recorded (deformation, fracture or both). For the assesment of keel bone deformation the following score system was used according to Li et al., (2016):
0: keel bone was intact with no deformation
1: keel bone was slightly deformed, the extent of deformation was less than 10%
2: keel bone was deformed, the extent of deformation was 10% to 50%
3: the extent of deformation was more than 50%
We measured other welfare parameters as well. We recorded foot lesions (hyperkeratosis, foot pad dermatitis, and bumble foot), comb pecking wounds, skin lesion, claws and feather scoring according to Tauson et al., (2004) on all birds with the neck, breast, tail, wings, back and cloaca/vent being scored. Feather scoring ranged from 1 (severe feather damage) to 4 (perfect feather coverage).
Egg samples were collected from each farm and production system. In total 300 eggs were analyzed for the estimation of external and internal egg quality characteristics. From “Rebra Commerce” farm 150 eggs were collected from Lohman Brown hens that were housed in fully equipped enriched cages and were in the middle of production cycle. Based on their size eggs were classified in five groups with 30eggs/group as follow: SU (70g and above), S (65-70g), A (60-65g), B (55-60g) and C (50-55g). Complementarily, 60 eggs were taken from the 38 wk and 56 wk hens that were palpated for KBD (30 eggs/production phase). From the “Animal Commerce” farm 60 eggs were collected (30eggs/production system). A sample of 30 eggs were also taken from “Organska Jaja” farm.

External egg quality traits evaluated were: egg weight, shell color, shell cleanness, shape index, shell breaking force, shell thickness and shell weight, while internal egg quality traits were: albumen and yolk height, yolk color, yolk width, yolk index, albumen and yolk pH, HU, meat and blood spots. Haugh Index was determined according to United States Department of Agriculture (USDA) guidelines.
Egg and shell weight were measured by electronic digital balance. Shape index was estimated by a handmade instrument made in Germany (Meapparat zur Bestimmung des Formindexes für Eier, August Fabian 8 München 55). Shell cleanness was evaluated by scoring system on a scale from 1 (very dirty shell) to 5 (completely clean). Shell color was visually evaluated with points 1 (weight) – 5 (dark). Shell breaking force was determined by instrument Egg Force Reader, which measures the weight in kg necessary to break an egg shell (Orka Food Technology Ltd, Israel). Shell thickness (mm) was measured using a dial gauge micrometer. Yolk color was determined according to Roche yolk color fan. Albumen and yolk height was measured using a tripod micrometer. Yolk width (mm) was measured with a metal caliper. Yolk index was represented by the ratio between height (mm) and diameter (mm) of the yolk: ID=(yolk height/yolk diameter)*100. Albumen and yolk pH was estimated using Hanna electronical pH meter with 0.01 accuracy. On the basis of egg weight and albumen height, HU score was calculated. The Haugh unit values were calculated for individual eggs according to following formula:
$HU = 100 \log (H + 7.57 - 1.7M^{0.37})$
H = albumen height, mm
M = egg weight, g
During the STSM observations were also made on laying hens housed in enriched cages as much they use perches during the day, depending on the body weight and welfare parameters. For this purpose, a total of 120 Lohmann Brown laying hens from Rebra Commerce farm, were randomly chosen from the same commercial flock that egg analysis was performed, and were divided at four cages with 30 hens per cage. The keel bone of each hen was palpated, and the occurrence of KBD was noted according to Li et al., (2016). In each cage the weight of each hen was measured. Based on body weight, hens were divided into two subgroups. The first subgroup (a) consisted of hens whose BW was lower than 1800g, and they were marked with a yellow strip on both legs. The other subgroup (b) consisted of hens that were heavier than 1800g, and they were not marked. The measurement and observation of hens was done at 38 weeks of age. Perching behaviors were observed using scan sampling during the period from 10:00 to 13:00, on three consecutive days.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The first investigation revealed that KBD was present only in two of the observed production systems (enriched cages and aviary system). In the farm with the organic system, laying hens spent most of their time outside. They used perches only during night. Perhaps that was the reason that birds were free from KBD. However, they had some problems with foot lessions mainly bumble foot but that is normal for this type of production system. In the aviary system, 56.4% of the birds had completely straight and flat keel, without deformation or fracture. However, KBD was recorded in 43.6% of the layers. In this production system 27.3% of the hens had deformation, 10.9% had fractures and 5.5% had both deformation and fractures. No other welfare problems were found in hens housed in aviary system.

At Rebra commerce farm, only deformation was recorded in laying hens at all three phases of production cycle with no fractures being observed. The lowest incidence of keel deformation (8.6%) was found in 38wk Hyline Brown laying hens. These birds were at the beginning of production cycle, they had good plumage scoring (3.81), with no problems with comb pecking wounds or skin lessions just small incidence of foot lessions (4.3% footpad dermatitis), while their claws had normal length. The average range of keel deformation recorded in Hyline Silver hens was 40.6%. Most of those birds (34.4%) had slightly deformed keel (score 1). Moreover, they had good feather coverage (3.63) with some problems mainly in wings, tail and breast whereas 18.8% of them presented claws of long length, 3.1% had bumble foot but no other welfare problems were recorded. 42.2% of Hyline Brown laying hens of 76 weeks of age had deformed keel bone whereas 57.8% of them had completely straight and flat keel (score 0). Moreover, from those hens with deformed keel 37.8% of them had score deformation 1, 2.2% score 2 and 2.2% score 3. Furthermore, at the end of the production cycle, 55.6% of the hens had claws with long length while 44.4% of them were recorded with claws of normal length. No other welfare problems were found in hens of 76 weeks of age. In Animal commerce farm, 29.2% of Lohman Brown hens 43wk old housed in enriched cages had KBD. 25% of those hens presented only deformation and 4.2% had both deformation and fractures. According to welfare parameters, they had perfect plumage scoring (3.95) with no other problems.
Concerning the observations of laying hens housed in enriched cages for as much they use perches during the day, depending on the body weight and welfare parameters the project is still in process. However, there are some first indications that the heaviest birds (BW>1800gr) use perches for longer time during the day than lighter ones (BW<1800gr). This result could probably be attributed to dominant behavior of heavier birds. Data analysis for the assessment of egg quality characteristics is also in process. Some first results (average values) are presented to the Tables1-3 for each of the visited farms.

Table 1. Average values of egg quality traits in “Rebra Commerce Farm”.

	Housing system		
	Enriched cages		
Phase of production cycle	Middle of production cycle		Beginning of production cycle
Genotype	Lohman Brown	Hyline Silver	Hyline Brown
Parameter	N=150	N=30	N=30
Egg Weight (g)	62.08	47.37	61.03
Shell Color (points)	3.10	3.70	3.27
Shell Cleanness (points)	1.01	1.00	1.00
Shape Index (%)	74.35	76.03	76.30
Shell Breaking Force (kg/cm^2)	4.92	4.50	3.19
Shell Thickness (mm)	36.95	37.00	37.00
Shell Weight (g)	6.29	7.40	7.77
Albumen Height (mm)	5.91	9.05	9.93
Yolk Height (mm)	17.76	19.58	19.45
Haugh Units	74.51	97.55	39.50
Yolk Color	13.59	14.77	15.00

Table 2. Average values of egg quality traits in “Animal Commerce Farm”.

	Housing system	
	Enriched cages	Aviary
Phase of production cycle	Middle of production cycle	Beginning of production cycle
Genotype	Lohman Brown	
Parameter	N=30	N=30
Egg Weight (g)	61.72	61.33
Shell Color (points)	3.17	2.87
Shell Cleanness (points)	1.00	1.00
Shape Index (%)	74.90	75.73
Shell Breaking Force (kg/cm^2)	4.67	4.74
Shell Thickness (mm)	39.00	36.00
Shell Weight (g)	7.68	6.15
Albumen Height (mm)	6.66	7.07
Yolk Height (mm)	19.01	18.75
Haugh Units	80.20	82.84
Yolk Color	14.73	14.70

Table 3. Average values of egg quality traits in “Organska Jaja” farm

	Housing system
	Organics
Phase of production cycle	Middle of production cycle
Genotype	Tetra SL
Parameter	N=30
Egg Weight (g)	54.27
Shell Color (points)	1.83
Shell Cleanness (points)	1.00
Shape Index (%)	73.17
Shell Breaking Force (kg/cm^2)	4.16
Shell Thickness (mm)	33.00
Shell Weight (g)	5.53
Albumen Height (mm)	4.94
Yolk Height (mm)	18.16
Haugh Units	69.88
Yolk Color	9.80

FUTURE COLLABORATIONS (if applicable)

Throuht this STSM, the collaboration between Veterinary Research Institute, Hellenic Agricultural Organization-Demeter, Thessaloniki, and University of Novi Sad, Faculty of Agriculture Department of Animal Science, Novi Sad was fostered. Both Institutions will continue working together on finding causes and solutions for KBD in laying hens. After all data analysis is completed a draft scientific paper will be written and the results will be presented at some of the upcoming welfare national or international congresses, with acknowlegments to the KBD COST Action 15224.

This STSM gave me the opportunity to expand my knowledge in keel bone damage and egg quality techniques, establish a network of researchers as well as to put the base for future collaborations and

publications.
Acknowledgement: Gratefully acknowledged to my wonderful host and colleague Professor Dr. Mirjana Đukić Stojčić's for the exceptional hospitality during my stay in Novi Sad. I would also like to truly thank my dear colleague Dr Evangelia Sossidou for all her encouragement and supportive spirit for my participation in this STSM. Many thanks to the COST Action CA15224 organization committee for all the support.