Organic World Congress 2020 | FRANCE

SEPTEMBER 21ST TO 27TH, 2020 IN RENNES
AT THE COUVENT DES JACOBINS • RENNES MÉTROPOLE CONFERENCE CENTRE
www.owc.ifoam.bio/2020

OWC 2020 Paper Submission - Science Forum

Topic 2 - Product and process quality in Organic Agriculture: methods and challenges

OWC2020-SCI-808

EFFECT OF WEATHER CONDITIONS ON THE FATTY ACID PROFILE OF MEDIUM-GROWTH CHICKEN MEAT REARED IN ORGANIC PRODUCTION SYSTEMS. NIR SYSTEM EVALUATION.

Ainhoa Sarmiento[1], Isabel Revilla[2], Carlos Palacios[*1], Inmaculada Gonzalez-Martín[3]

[1]Animal Production, [2]Tecnologia de los alimentos, [3]Quimica Analítica, University of Salamanca, Salamanca, Spain

Preferred Presentation Method: Poster only

Full Paper Publication: Yes

Abstract: A total of 160 medium-sized one-day-old male chickens were raised for 120 days in a certified organic farm farming system. The chicks were classified according to the weather period (P1 and P2). A total of 80 chickens were used for each breeding period (8 repetitions with a total of 10 chickens/group). The characteristics of the weather period were defined based on the information provided by the SiAR; P1 were colder than P2. All birds were provided with the same diets. After 120 days, the animals were taken to a certified slaughterhouse for organic meat where they were slaughtered. A total of 24 chicks per period were randomly selected, then the breasts (*Pectoralis major*) were extracted to the analysis. Individual fatty acids were measured by gas chromatography and expressed in grams per 100g / fat. From the values obtained, the total lipid fractions were calculated. NIR spectra were measured on the surface of the breast without preparing or manipulating. Warmer period (P2) significantly decreased ($P < 0.01$) the content of saturated fatty acids (SFA) and ratio between SFA /polyunsaturated fatty acids (PUFA), and increased ($P < 0.05$) content in PUFA and n-6 in the breast. However, no significant differences were observed on the individual composition of fatty acids. The NIR system was not able to correctly classify the samples according to the aging period.

Introduction: Changes in temperature have been described as factors capable of influencing not only the development of animals but also the quality of meat. This could be very important in organic production, because the animals grazes abroad for long periods of time when important temperature variations can occur. However, at the moment, it is unknown, if these uncontrolled environmental conditions could influence the lipid composition of the meat. Near infrared spectroscopy (NIR) has been useful for classifying meat according to different criteria (Sun *et al.* 2012). Our study proposes to evaluate the effect of the climatic period on the fatty acid profile of the organically raised chickens and analyze the ability of the NIR system to classify samples according to these conditions.

Material and methods: A total of 160 one-day-old male chickens (*Gallus gallus domesticus*) from medium-grown lines, were raised for 120 days in a certified organic farm farming system.Were selected for the study. 80 chicks were assigned for each period (P1 and P2). Each batch of chicks consisted of 10 animals; each batch being considered as a repetition; This means a total of 8 repetitions for each period. The climatic period (P1 and P2) was determined based on the

conditions that affected the chickens from the second month of life (which is when the animals had access to the outside) until their sacrifice (120 days). The climatological values were obtained from the base of the network of agrometeorological stations of the Agroclimatic Information System for Irrigation (SiAR). P2 group was shown an increase on the values of average temperature (+7.54 °C), maximum daily temperature (+9.49 °C), minimum daily temperature (+5.35 °C) and radiation (+3.4 Mj /m^2); while there was a decrease in the values of average relative humidity (-14.55 %), air velocity (-0.5 m/s) and rainfall (-0.77 mm) with respect to the P1 group. It is therefore observed that P2 was a warmer period, which could be related to the spring-summer seasons, compared to P1, which would correspond to the autumn-winter. Both situations are common in raising chickens in organic production systems. All chicks received the same feed throughout the study. On day 120, the chicks were slaughtered in accordance with the regulations for the slaughter of organic production animals (RD 37/2014). A total of 48 chicks were randomly selected to carry out the quality analysis. After 15 minutes post-mortem, the breast (Pectoralis major) was removed and sent to the refrigerated laboratory where the samples remained frozen at -18 °C. The breast was divided longitudinally into two subsamples (A1, A2,). Sample A1 was homogenized, and was used to determine the fatty acid profile that was performed by gas chromatography according to the method described by Lurueña *et al*. (2010). From the data obtained, the total lipid fractions were calculated. Statistical analysis (ANOVA) were performed using the SPSS software package (IBM SPSS Statistics 23). Significant differences were established when $P<0.05$. The NIR spectrum was recorded on subsample A2, that were thawed at 4 °C for 24 hours and subsequently the recording was carried out. The NIR spectra were recorded using a Foss NIRSystem 5000 device, with a standard 1,5 m 210/210 standard bundle-fiber optic probe that used a remote reflectance fiber and a ceramic plate as a reference. The window was of quartz with a 5 cm × 5 cm surface area. The NIR spectrum was obtained by applying the window directly onto the surface of the sample. All the analysis were carried out in triplicate. A discriminant analysis of the weather period was carried out by means of D-PLS method. The software used was WinIsi 1.5 (Foss).

Results: For both periods, predominant fatty acids in chicken breast (Table 1) were palmitic acid (C16:0) and stearic acid (C18: 0) as SFA; oleic acid (C18:1 n-9c) as MUFA and linoleic acid (C18:2 n-6c) as PUFA. No significant differences ($P>0.05$) were observed between both periods when fatty acids were analyzed individually. However, there was a significant increase ($P <0.05$) in ΣPUFA content (40.58 *vs.* 36.44) and Σn-6 (39.41 *vs.* 35.27) and a decrease in content in SFA (31.55 *vs.* 33.97) and in the SFA/PUFA ratio (0.78 *vs.* 1.0) in the period 2. The rest of the fractions were not affected. It was not possible to classify the samples according to the breeding period to which they belonged (P1 and P2). Figure 1 shows the mean NIR spectrum for the samples of both periods.

Table 1. Effect of weather on breast fatty acid profile

	P1			P2			P
Miristic (C14:0)	0,88	±	0,400	0,69	±	0,224	ns
Miristoleic (C14:1 n-5)	0,18	±	0,101	0,15	±	0,072	ns
Palmitic (C16:0)	22,24	±	2,307	21,06	±	1,385	ns
Palmitoleic (C16:1 n-9)	3,86	±	1,613	2,90	±	1,361	ns

Heptadecanoic (C17:0)	0,15	±	0,046	0,17	±	0,031	ns
Stearic (C18:0)	6,75	±	3,109	8,56	±	2,418	ns
Oleic (C18:1 n-9c)	24,32	±	3,096	25,14	±	2,165	ns
Elaidic (C18:1 n-9t)	1,94	±	0,333	2,08	±	0,284	ns
Linoleic (C18:2 n-6c)	27,78	±	2,843	28,14	±	2,326	ns
α-Linolenic (C18:3 n-3)	0,81	±	0,421	1,17	±	0,474	ns
ɣ-Linolenic (C18:3 n-6)	0,22	±	0,061	0,19	±	0,062	ns
Arachidic (C20:0)	0,09	±	0,088	0,07	±	0,034	ns
A.Docosadienoic (C20:2 n-6)	0,22	±	0,061	0,19	±	0,062	ns
A.Eicosatetraenoic (C20:4 n-3)	1,00	±	0,048	1,01	±	0,093	ns
Arachidonic (20:4 n-6)	8,93	±	3,176	6,32	±	1,001	ns
DPA (C22:5 n-3)	0,33	±	0,048	0,36	±	0,093	ns
ΣSFA	33,96	±	3,092	31,19	±	3,240	**
ΣMUFA	29,87	±	5,520	28,64	±	3,343	ns
ΣPUFA	36,45	±	6,780	40,49	±	3,880	*
SFA/PUFA	1,00	±	0,375	0,78	±	0,133	*
n-3	1,06	±	0,687	1,12	±	0,415	ns
n-6	35,27	±	6,520	39,32	±	3,659	*
n-6/n-3	43,53	±	26,512	40,30	±	16,366	ns

The results are presented as mean ± standard deviation. ns = Not significant; * $p < 0.05$

Discussion: Chemical composition of the breast can be modified by changes in temperature. However, studies consulted have been carried out in industrial systems with controlled temperature conditions in a given period. This differs from the

conditions raised in our study. However, it should be considered that, although in all cases the animals had access to the outdoors and consequently to the pasture, during warm conditions (P2) it is likely that the chickens would ingest a greater amount of it due to the increase in their availability. This is in accordance with that described by Ponte *et al*. (2008) who attributed the differences found on the composition of fatty acids rather than the breeding season, to the availability of the grass. Then, Žlender *et al*. (2000) and Meluzzi *et al*. (2010) who considered that the differences found in their studies can be attributed to the higher intake of pastures of some groups compared to others. The linoleic acid (C18:2) present in pastures causes the decrease in MUFA content, predominantly oleic acid (C18:1) and the increase in α-linolenic acid (C18:3) (being 11 % higher than in the case of chickens raised in intensive systems), and to a lesser extent, of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Žlender *et al*. 2000). Although not significantly, similar trends were observed for these fatty acids in our study. In addition, the amount of PUFA n-6 and n-3 fatty acids available in grasses grows linearly, first, linoleic acid and then linolenic acid (Žlender *et al.,* 2000), which coincides with what is described in our study. Bibliography consulted has not shown data referring to the study of the NIR system to classify meat samples according to environmental conditions, but rather, to the food received (Sun *et al.,* 2012). These authors evaluated lamb meat from different geographical areas, concluding that the correct classification of the samples was produced not because of the environmental conditions, but because of the large differences in the food received. Figure 1 shows a superposition of the records corresponding to both periods, which justify the difficulty of this system to differentiate between samples with a very similar composition.

References: Lurueña-Martínez MA, Palacios C, Vivar-Quintana AM, Revilla I (2010).Effect of the addition of calcium soap to ewes diet on fatty acid composition of ewe milk and subcutaneous fat of suckling lambs reared on ewe milk. Meat Science, 84.677-683.

Meluzzi A,Sirri F,Castellini C,Roncarati A,Melotti P,Franchini A (2010).Influence of genotype and feeding on chemical composition of organic chicken meat. Italian Journal of Animal Science, 8. 766-7688.

Ponte PIP,Alves SP,Bessa RJB,Ferreira LMA,Gama LT,Bras JLA,(2008).Influence of Pasture Intake on the Fatty Acid Composition, and Cholesterol, Tocopherols, and Tocotrienols Content in Meat from Free-Range Broilers. Poult Science, 87.80-88.

Sun S,Guo B,Wei Y,Fan M,(2012).Classification of geographical origins and prediction of δ13C and δ15N values of lamb meat by near infrared reflectance spectroscopy. Food Chemistry ,135. 508-514.

Žlender B,Holcman A,Stibilj V,Polak T,(2000).Fatty acid composition of poultry meat from free range rearing. Agris, 6. 81.

Image:

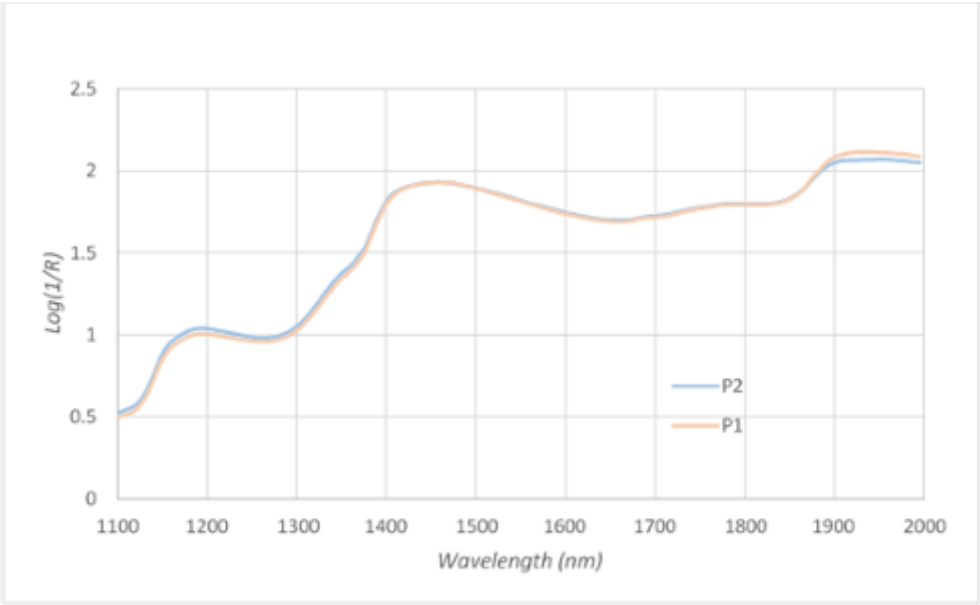

Figure 1. NIR spectra of the samples according to weather period (P1 and P2)

Disclosure of Interest: None Declared

Keywords: poultry meat, physicochemical aspects