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Ecological aspects of the Mangalitsa pigs' behavior

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Abstract. The topic of ecological contribution of the livestock farming to the environment is becoming more and more popular during the last years. Based on the specificity of the species, we have used drone footage, as well as records on ethogram sheets to establish the frequency of basic behavioral responses of the fattening pigs of the Mangalitsa breed. The herd consists of average 24.16 (ranging from 21 to 28) female and male castrates, aged 1 to 3 years. The animals have been observed during the daylight hours from 8 am. to 8 pm. The pigs spend most of their time resting – average 78.36%, eating - 7.78%, rooting and exploring the environment - 6.6%, drinking - 0.8%, excretion - 0.15%. The time of the day has a reliable influence on a number of ethological acts – eating, drinking, walking, rooting and exploring and resting ($P \leq 0.001$), hierarchical ($P \leq 0.05$) and comfortable behavior ($P \leq 0.01$). The interval between readings is a reliable source of variation in excretory behavior ($P \leq 0.05$). Understanding the ethology in pigs would improve animal welfare and health, as well as limit harmful emissions from pig farming and environmental protection.

Key words: drones, ecology, excretory behavior, free-range, Mangalitsa, rooting, swine.

Introduction

The ecological role of the livestock farming for the environmental protection becomes even more relevant. By their behavior, the species such as swine can lead to decrease in the economic efficiency of produce and have a negative impact on the biodiversity (Bankovich et al., 2016), or be a positive factor to the ecosystem protection (Daza et al., 2008).

The behavioural reactions of the animals, together with their physiology and health, are indicators of their well-being. Ethological observations are cumbersome and require costly manpower, and precision is limited (Arulmozhi et al., 2021). According to the authors, the adoption of modern precision farming techniques is of utmost importance to achieve high performance in pig husbandry.

Becoming more and more accessible in the past few years, drones can be turned into a tool to study animal populations and habitats, to observe their behaviour, spatial structure and movement of groups (Iglesias & Camerlink, 2022; Schad & Fischer, 2022; Wang et al., 2022). According to Berckmans (2017), the goal of smart livestock farming is to manage individual animals by continuously monitoring health, welfare, and environmental impact, in real time. The author considers it prudent to use non-invasive and non-contact ways of detecting changes in animal behaviour when developing systems for timely notification of the farmer.

Monitoring the behavioural responses of animals is of utmost importance to detect abnormalities in their farming. The relatively short monitoring periods by farmers allow the iden-

tification of significant problems in animals when it may be too late to effectively correct them (Matthews et al., 2017). According to Barbedo et al. (2019), it is drones that are becoming an invaluable aid in farm management, especially in extensive farming.

This is the first for Bulgaria study with animals of the Mangalitsa breed, which will give us the opportunity to understand their behavior likewise in their ecological aspect.

Materials and methods

The study was carried out on a herd of Mangalitsa pigs, on ecological farm around the village of Banya, Razlog municipality, south-western Bulgaria, during the summer season including the months of June, July, and August 2023 and 2024. The habitat of the animals includes about 70% an open area, but the remaining is held by conifers. The animals, subject to the study are kept outdoors year-round in fenced yards with electric fencing, and are aged 1 to 3 years. Behavioural assessment of the pigs was done using pre-prepared ethogram forms. Recordings on the forms were made every 15 minutes, from 08:00h to 20:00h, two days in a row, monthly, and for one day every 5 minutes in August 2024. The frequency of occurrence of basic behavioural responses was calculated: eating, drinking, resting, exploring (rooting and interacting with objects), walking, hierarchical and comfort behaviours, urinating, and defecating, trying to get as close as possible to the ethological behaviours described by Stäbler et al. (2022). Temperature data were also included with the behavioural information, and values were recorded every hour using a mobile application called YR by NRK and the Norwegian Meteorological Institute. The number of animals included in the experiment averaged 24.16 (ranging from 21 to 28) female and castrated males.

In parallel with the observations, the behaviour of the pigs was remotely monitored by an unmanned aerial vehicle. For this purpose, a DJI drone, model Mavic Air, equipped with a 4K Ultra HD camera with 12 MP CMOS sensor and an optical lens with 85° viewing angle was used. The drone has a good real-time picture transmission at a mobile control distance of up to 80 m and a flight height of up to 50 m. The drone is lightweight, small, and sufficiently maneuverable for the purpose of the study, but should only be used in dry weather and in appropriate wind power of up to 8 m/s, in open terrains.

After the team ensured that the drone did not cause a stress response from the animals, the actual observation was conducted at a 2-meter hovering height. The video recordings were reviewed and the frequency of behavioural responses on the parameters indicated was recorded by the same team of observers. Taking into account the time between observations (recordings from the ethogram forms and the remote monitoring), we divided the frequency of ethological behaviours into three groups - when reporting up to 5 min, from 6 to 9 min, and from 10 to 15 min, and the mean interval was calculated to be 8.9 min.

The study methodology was reviewed and approved by the Experimental Animal Ethics Committee of the Agricultural University - Plovdiv, with permission № 2023-012.

The data were processed statistically by multivariate analysis of variance following the following model:

$$\boldsymbol{Y_{ijkl} = \mu + H_i + IN_j + ZF_{ij} + eijkl}$$

where: Y_{ijkl} - observation vector; μ – general average constant; H_i - is a fixed effect of the time of day (i=12); IN_j - interval between readings (j=3); ZF_{ij} - interval between readings in time of day, eijkl- residual variant

The mathematic analysis was performed with program SPSS v.24.

Results and Discussion

Based on the data collected from the experiment, we found that the time of day had a significant effect on a number of ethological manifestations such as eating, drinking, walking, rooting and exploring, and resting ($P \leq 0.001$), hierarchical ($P \leq 0.05$) and comfort behaviour ($P \leq 0.01$) (Table 1). The interval between readings is a reliable source of variation in excretory and sexual behaviour. We might assume that the category of behaviour and its frequency are influential in this case, so that there is an opportunity to report, but at shorter intervals between observations.

Figure 1 depicts the hourly dynamics for some of the main studied behavioural manifestations. On average, animals in the conducted experiment spent 78.36% of their time resting, eating - 7.78%,

rooting and exploring - 6.6%. The pigs were lying for most of the day, which is in line with the results of Ekkel et al. (2003) who reported that the number of animals weighing 100 kg in the recumbent position reached 87.5. The long duration of recumbence was found to be a key point for assessing their welfare (Arulmozhi et al., 2021). Horsted et al. (2012) identified resting followed by rooting as the most frequent ethological behaviour. The frequency of occurrence of this behaviour in our experimental conditions increased with increasing daily temperature (Fig. 2), reaching 93.87% in the 14:00h - 15:00h time range. The values of this index indicate that for almost 5 hours of daylight, about 90% of the animals were lying down. During the midday hours, when the pigs are resting, the incidence of other behavioural responses is minimized.

Based on the fact that feeding with concentrate fodder is twice a day, in most cases in the morning between 06:30h and 07:30h and in the afternoon between 16:30h and 17:30h, two peaks in this indicator are also logically formed, the first being between 08:00h and 09:00h (15.67%), and late afternoon until 18:00h (22.1%) (P≤0.001) (Fig. 1). Despite being regularly fed, pigs spent about 7% of their time during the day in exploratory behaviour (rooting and exploring soil and objects). Pigs explored significantly more (P≤0.001) around and shortly after feeding time, with the frequency of this occurrence reaching 13.8% and 10.8% during morning and evening hours, respectively. According to Martínez-Macipe et al. (2020), when analyzing the frequency of rooting, it is important to consider the need to search for food as well as the age of the pigs. Understanding the behavior during rooting would be useful in predicting the impact that the animals will have on ecosystems (Elledge et al., 2013). Exploration of the soil and the surroundings through rooting, sniffing and various other interactions is a characteristic feature of the species and should be taken into account when constructing modern pig pens (Stäbler et al., 2022).

Little is known about the origin of the need for pigs to urinate and defecate in places outside the feeding and resting area, but this is considered to be typical for pigs to avoid contact with their excreta (Nannoni et al., 2020). Understanding the ethology regarding urination and defecation in pigs would improve animal welfare and health, as well as limit harmful emissions from pig farming, moreover the correct use and storage should be a primary concern for organic farms so they can avoid conflict with the environment (Cristiana & Mirela, 2018). Throughout the time of their study, Horsted et al. (2012) examine the relationship between the excretory behavior of the pigs and the extent of the damage to crops in the context of environmental protection. During our experiment, pigs spent an average of 0.84% of their time drinking, and 0.15% in excretory behaviour (urination and defecation) (Fig. 3), with these behaviours occurring most frequently in the morning and evening around peak feeding times, in designated areas. These results are consistent with the study of Vermeer et al. (2015), according to which, eating, drinking and excretion occur in a specific sequence. A significant correlation between acts of drinking and excretion, culminating in the midday hours was also reported by Guo et al. (2015).

Table 1. The effect of some factors on the ethological manifestations

Traits / Factors	**F-criterion and degree of reliability**					
	Time of the day		Interval between readings		Interval between readings * Time of the day	
	F	Sig.	F	Sig.	F	Sig.
Eating	26.245	***	2.470	-	10.912	***
Drinking	4.867	***	5.046	*	2.634	***
Rooting and exploring	19.718	***	6.268	**	10.496	***
Walking	12.185	***	0.000	-	5.730	***
Resting	45.011	***	0.067	-	19.239	***
Urinating and defecating	1.672	***	3.331	*	1.480	*
Comfortable behaviour	2.626	-	1.885	-	1.515	*
Hierarchical behaviour	2.434	**	1.216	-	1.240	-
***P<0.05, **P<0.01, ***P<0.001**						

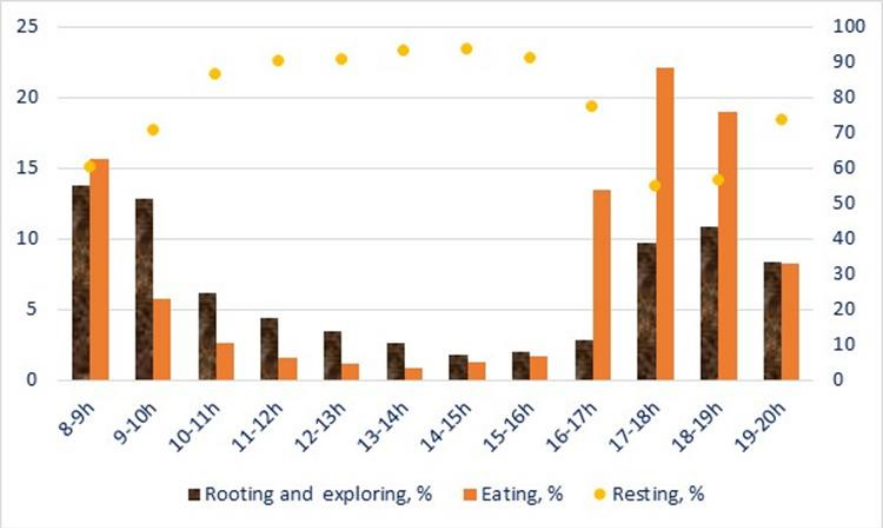

Fig. 1. Hourly dynamics of rooting and exploring, eating and resting, %.

Fig. 2. Hourly dynamics of mean temperature values on study days, °C.

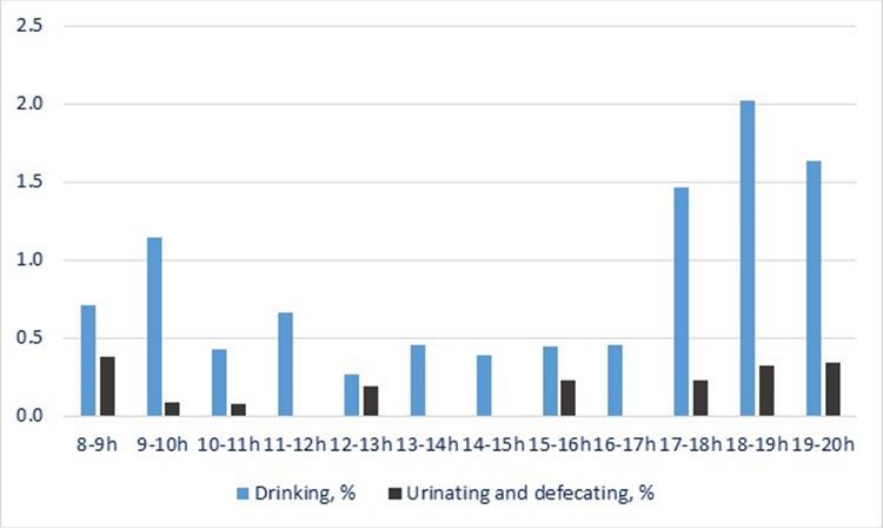

Fig. 3. Frequency of drinking and excretory behaviour, %.

Responses of hierarchical and comfort behaviour described by Stäbler et al. (2022) are represented in 0.27 and 0.6%, respectively (Fig. 4). Significantly more dominant reactions occurred in the evening hours, during mealtimes and choice of a lying place (P≤0.01). When interpreting these results, the category of animals should also be considered. At the time of the study, they were between 1 and 3 years old, and most likely had already established their dominant-subordinate structure. Furthermore, older animals have fewer and different forms of agonistic displays in establishing hierarchy compared to younger animals (Puppe et al., 2008). Scratching and rubbing as elements of comfort behaviour were exercised by the animals on trunks of cut trees or in the corners of the three-walled shelter located in the resting area. Rørvang et al. (2023) suggest that these ethological behaviours may be a way for the body to obtain a certain odour on the one hand, and on the other hand as an attempt to clean the skin of ectoparasites. In our experiment, the signs of comfort behaviour were recorded in each period of daily observation, and their incidence was highest between 09:00h and 10:00h and in the evening in the interval between 18:00h and 19:00h (P≤0.01), when the animals were most active.

Walking as a way of moving the animals is on it is highest percentage in the morning between 8 a.m. and 9 a.m. and in the late afternoon between 5 p.m. and 6 p.m. Despite the animals' long rest time, it is disrupted in 1.2% (2-3 p.m.), when the frequency of this ethological element is on its lowest (Fig. 4).

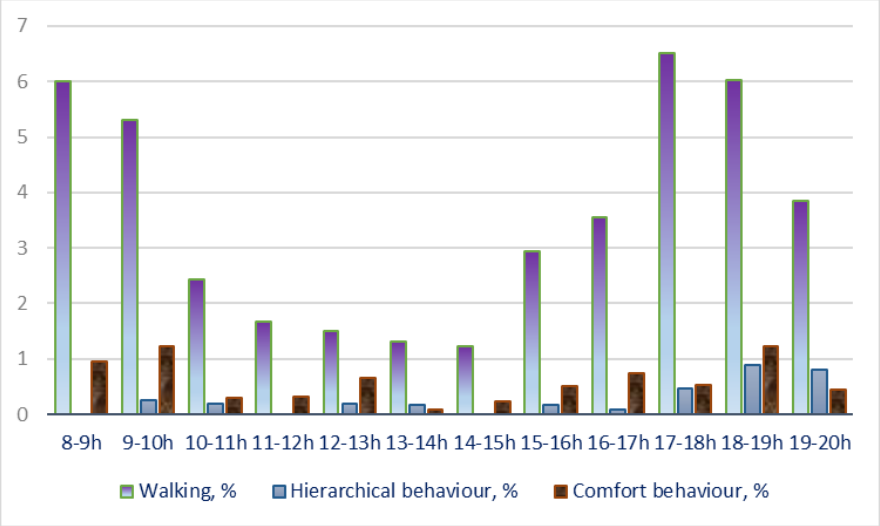

Fig. 4. Frequency of walking, hierarchical and comfortable behaviour, %

Conclusions

During the period of our observation, pigs spent most of their time lying down - 78.36% on average, eating - 7.78%, rooting and exploring the environment - 6.6%, drinking - 0.8%, excretion - 0.15%. The time range significantly influenced a number of ethological behaviours such as eating, drinking, walking, rooting and exploring and resting (P≤0.001), hierarchical and comfort behaviour (P≤0.01). The interval between readings is a reliable source of variation in excretory behaviour (P≤0.05). Knowledge of the ethological characteristics of pigs could be used to improve their health and welfare. As a first study for Bulgaria with Mangalitsa breed, the understanding over the natural behavior of the pigs may be useful in the context of problems in the ecological balance and environmental protection.

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