Iron Deficiency Anemia (*IDA*) in sows – an emerging problem?

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Citation: Sperling, D., Guerra, N., & Dimitrov, S. (2021). Iron Deficiency Anemia (*IDA*) in sows – an emerging problem? *Zhivotnovadni Nauki*, *58*(5), 47-52 (Bg).

Abstract

The aim of this study is to provide information on the prevalence of Iron Deficiency Anemia (*IDA*) in sows and risk factors associated with parity for prevalence of *IDA* in weaning piglets in important pig-producing countries in the EU countries.

A survey was conducted in ten EU countries (Denmark, Poland, Belgium, the Netherlands, Germany, Austria, the Czech Republic, France, Italy and Portugal). Total 637 sows of different parity were included in the assessment of hemoglobin (Hb) levels at weaning of their corresponding litters at randomly selected farms that were willing to participate in the survey. The corresponding level of Hb of three selected piglets per litter (small, medium, large piglet) was measured at weaning. Hb levels were measured using the portable analyzer HemoCue Hb 201+. The current criteria for assessment of anemia based on Hb levels were used: anemia < 9 g/dL, subclinical status 9 – 11 g/dL and optimal Hb level > 11 g/dL for piglets and 10 g/dL for sows. High level of *IDA* in sows was observed, where 47.1% sows (300/637 in total) were anemic at weaning. Piglets from first and second parity sows were at risk of *IDA* at weaning compared to higher parity sows ($p = 0.0063$), with *IDA* being confirmed in 17.4% of piglets from this particular sub-group.

In our study *IDA* is a common problem in sows on European farms, with more than 47% of sows reported as being anemic at weaning. Piglets from young sows (first and second parity) had the highest percentage of anemic piglets at weaning, so special attention should be paid to these animals.

Keywords: Anemia, *IDA*, sows, hematology, HemoCue

Abbreviations: *IDA* – iron deficiency anemia, Hb – hemoglobin

Желязодефицитна анемия (*IDA*) при свине майки – възникващ проблем?

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Целта на проучването е да предостави информация за разпространението на желязодефицитната анемия (*IDA*) при свине майки и отбити прасета.

Проучването е извършено в десет държави от ЕС (Дания, Полша, Белгия, Холандия, Германия, Австрия, Чехия, Франция, Италия и Португалия) в произволно избрани ферми. Изследвани са нивата на хемоглобин (Hb) при 637 бр. свине майки с различна поредност на опрасване и на по три броя прасета от всяко прасило (визуално избрани по размер – малко, средно и голямо) при отбиването на животните. Стойностите на Hb са измерени с преносим анализатор HemoCue Hb 201+. Критерии за оценка степента на анемия относно нивата на Hb при животните са следните референтни стойности: за отбити прасета – анемия до 9 g/dL, субклиничен статус 9 – 11 g/dL, оптимално ниво на Hb над 11 g/dL и за свине майки – 10 g/dL. Отчетено е високо ниво на *IDA* при свинете майки, като 47,1% са с признаци на анемия при отбиване. Прасетата от свине майки на първо и второ прасило са с най-висок риск от от проявата на *IDA* при отбиване (17,4%) в сравнение с тези от свинете с по-голям брой опрасвания (p = 0,0063).

В настоящото проучване е установено, че *IDA* е често срещан проблем при свине майки в проучваните европейски ферми при установени повече от 47% при отбиване. Отбитите прасета на млади свине майки (първо и второ прасило) са с най-висок процент на анемия.

Ключови думи: свине, анемия, хематология, HemoCue

Съкращения: *IDA* – желязодефицитна анемия, Hb – хемоглобин

Introduction

It is well established that insufficient iron intake (*Insuffientia ferri)* in suckling pigs results in iron deficiency or development of Iron Deficiency Anemia (*IDA*), with negative impact on health status and production results. Anemia due to iron deficiency, also termed as hypochromic microcytic anemia, may lead to increased susceptibility to infections, affection of immune system, with consequent poor growth and increased pre-weaning mortality (Svoboda et al., 2017). Recently, 14.7% of piglets were anemic at weaning based of assessment of hemoglobin (Hb) in EU survey, with significant differences between included countries ($p < 0.0001$) (Sperling et al., 2021 a). Less is known about hematologic variables of the sows at farrowing and around weaning period, only few studies reported hematological reference intervals for gestating sows (Friendship et al., 1984; Thorn, 2010; Bhattarai et al., 2019 a). Hematological variables are considered as important tool for pig producers and becoming important part of regular health monitoring on the swine farms with current hyper-prolific genetics. The screening is usually focused on evaluation of hemoglobin (Hb) in piglets at weaning, but sows are not regularly considered. Hb levels and percentage of anemic piglets at birth might be associated to Hb of the sows at farrowing and knowledge about status of breeding animals might be beneficial (Bhattarai et al., 2019 a). Association between Hb concentration and other hematinic indices at farrowing and reproductive performance was described (Bhattarai et al., 2018). For example, risk of increase of stillbirth was negatively associated with Hb levels and other hematological parameters of sows, especially in the animals on higher parity (Zaleski and Hacker, 1993; Bhattarai et al., 2019 b).

The aim of this study is to provide information on the prevalence of *IDA* in sows and risk factors associated with parity for prevalence of *IDA* in weaning piglets in important pig-producing countries in the EU countries.

Materials and Method

Animals

A survey was conducted in ten EU countries (Denmark, Poland, Belgium, the Netherlands, Germany, Austria, the Czech Republic, France,

Italy and Portugal). Study was performed on farms, that were willing to participate in the survey. In total, 2038 piglets from 694 randomly selected sows with recorded parity were included in the assessment of hemoglobin (Hb) levels at weaning. The level of Hb of three selected piglets per litter (small, medium and large piglet) was measured at weaning (Bhattarai and Nielsen, 2015). Piglets were divided into 3 categories based on visual assessment of litter. Sows were divided based on their parity into following categories: Young (parity 1 and 2), Medium (parity 3 – 5) and Old (parity 6 and higher) and effect of parity on Hb level of piglets at weaning was evaluated. 637 sows were consequently checked for their Hb level at weaning. Included sows were of different parity in order to represent parity structure of the corresponding farrowing batch.

Blood chemistry analysis

Hb levels were measured using the portable analyzer HemoCue Hb 201+. One droplet of blood was collected from the ear vein from all sows and corresponding, selected piglets per sow. Fixed volume of blood was aspirated by capillary force into a disposable microcuvette according to manufacture recommendation just after the puncture. Hb level was determined by inserting the microcuvette into a device measuring the haemoglobin concentration by means of a photometer (HemoCue Diagnostics). The device, originally developed for human medicine, can be used on the farm (in the farrowing unit) and the result is obtained within one minute and was successfully used in previous studies (Maes et al., 2011). The current criteria for assessment of anemia based on Hb levels were used: anemia < 9 g/dL, subclinical status 9 – 11 g/dL and optimal Hb level > 11 g/dL for piglets and > 10 g/dL for sows (Bhattarai and Nielsen, 2015; Bhattarai et al., 2019 a).

Statistical analysis

Statistical analyses included descriptive statistics, identification of outliers and statistical tests (unpaired T-test and Kruskal-Wallis test). P-value < 0.05 was considered to be significant and $p \leq 0.10$ was a near-significant trend. Testing for significance was done on a 95% CI. Statistical analyses were performed by using GraphPath Software (San Diego, CA 92108, USA).

Results

High level of *IDA* in sows was observed, where 47.1% sows (300/637 in total) were anemic at weaning (Fig. 1). Mean level of Hb was 9.957 ± 1.25 g/dL. For detailed descriptive statistics see Table 1.

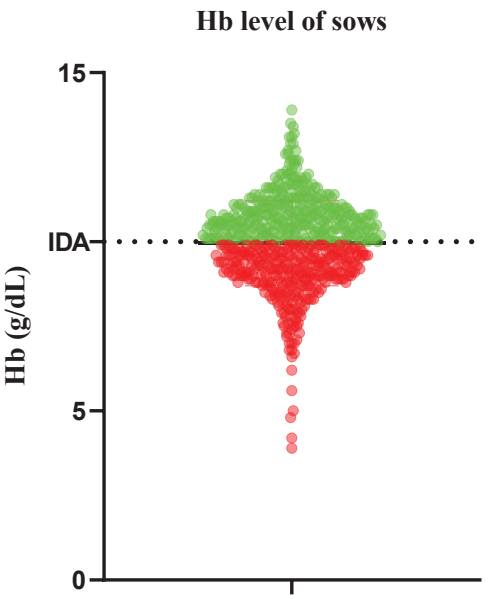

Fig. 1. Hb level distribution in sows (g/dL)

Table 1. Descriptive statistics of Hb level of sows (g/dL)

Metric	Value
Number of sows	637
Minimum	3.9
25% Percentile	9.2
Median	10
75% Percentile	10.7
Maximum	13.9
Range	10
Mean	9.957
Std. Deviation	1.253
Std. Error of Mean	0.04965
Coefficient of variation, %	12.59

Piglets from first and second parity sows were at risk of *IDA* at weaning (p = 0.0063), with *IDA* being confirmed in 17.4% of piglets from this particular sub-group. The frequency of *IDA* in piglets from Medium and Old group of sows was 15.5% and 17.2% respectively (Fig. 2). Difference was observed as well in case of the percentage of the piglets, which are considered as optimal based on the Hb level at weaning (> 11 g/dL), with 32.1% piglets from young sows compare to 39.1% and 34.2% in medium and old group respectively. Trend of higher prevalence of *IDA* in piglets from old sows (parity 6 and higher) was also confirmed compare to Medium group (Table 2).

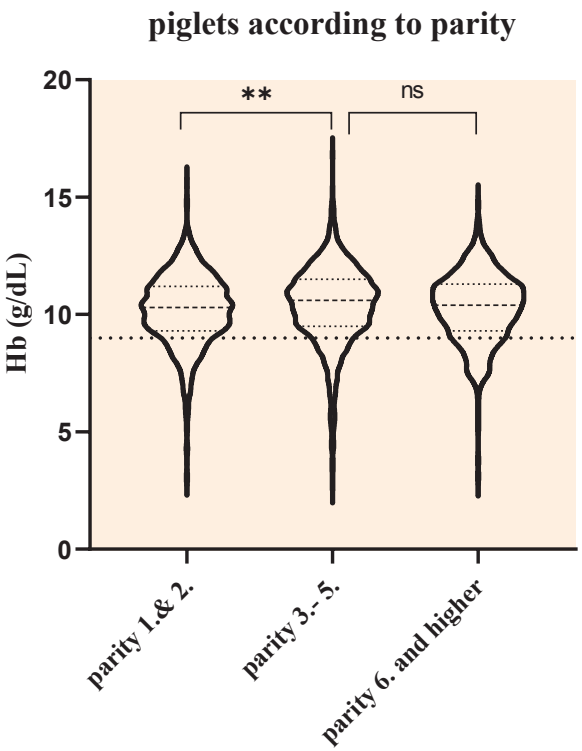

Fig. 2. Hb level distribution in piglets at weaning according to parity of sows (g/dL)

Discussion

The presented study reported Hb levels and frequency of *IDA* in sows at the time of weaning of their progeny, observed on different farms in selected EU countries. Hb level is frequently used parameter for diagnostics of anemia (*IDA*), sows with Hb value less than 10 g/dL were considered as anemic (Bhattarai et al., 2019 a). The threshold for sows was established for current, highly prolific sows. Frequency of *IDA* in sows observed in our study was 47.1% (300/637 in total) and was higher compare to previously reported results in sows from Danish farms (18.1%) (Bhattarai et al., 2019 a). The differences might be explained by rather small group of sows in Danish study representing only one farm (160 in total). The mean Hb level in our study (9.96 ± 1.25 g/dL) was lower compare to study done in Ontario swine from various age groups (Friendship et al., 1984). Hb values and references may vary greatly between the breeds, age, season, physiological status, sample size and management factors (Bhattarai et al., 2019 a). Different time interval for sampling and physiologi-

Table 2. Descriptive statistics of Hb level of piglets at weaning according to the parity of the sow (g/dL)

Metric	Parity 1 & 2	Parity 3 – 5	Parity 6 and higher
Number of piglets	789	831	418
Minimum	3.000	2.700	3.100
25% Percentile	9.300	9.500	9.300
Median	10.30	10.60	10.40
75% Percentile	11.20	11.50	11.30
Maximum	15.60	16.80	14.70
Range	12.60	14.10	11.60
Mean	10.19	10.38	10.26
Std. Deviation	1.535	1.682	1.501
Std. Error of Mean	0.05464	0.05835	0.07344
Coefficient of variation, %	15.07	16.20	14.63

cal status of sows (weaning x farrowing) might influence results as well, as reported for certain biochemical parameters and the stage of reproduction (gestation) of the sow (Friendship et al., 1984). The situation can become even worse in highly prolific sows, typical genetics nowadays. Greater number of piglets and high milk productivity may affect the Fe status of the sow (Mahan and Newton, 1995). Further studies are needed in order to establish influence of Hb status and *IDA* on reproductive parameters.

Piglets from young sows (1st and 2nd parity) were at higher risk of *IDA* at weaning compare to progeny from medium sows (3rd – 5th parity) in our study, with higher frequency of *IDA*. Primiparous sows have higher nutrient requirements, fewer piglets born with lower birth weight and growth performance than multiparous sows as well second parity syndrome is frequently observed on sow's farms (Piñeiro et al., 2019). Other negative consequence might be higher risk of *IDA* in piglets born to young sows. Highly prolific sows have a lower body Fe content than sows with decreased prolificacy and less iron might be available for transfer to the developing foetus or to the mammary tissue, like was described by Peters and Mahan, 2008. The problem might be even more serious in piglets from young breeding animals.

Different dextran- or gleptoferron-based injectable products are available on the market. Gleptoferron is a macromolecular complex of beta-ferric oxyhydroxide and dextran glucoheptonic acid, with differences described in absorption levels between gleptoferron and iron dextran (Sperling, Meppiel and Karembe, 2021 b). Effective product must be rapidly and significantly absorbed from the intramuscular injection site, for haemoglobin synthesis and replenishment of iron stores (liver). For treatment and metaphylaxis of *IDA* in sows, preferably injection to sows at risk should be used.

Conclusions

In our study, Iron deficiency anemia (*IDA*) was recorded as a common problem in sows on European farms, with more than 47% of sows reported as being anemic at weaning. Piglets from young sows (first and second parity) had the highest percentage of anemic piglets at weaning as well lower percentage of optimal piglets according to the Hb level, so special attention should be paid to these animals. Improvement of iron management of sows might be recommended.

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