

PRODUCTION TECHNOLOGY, QUALITY AND ECONOMY IN BEEF CATTLE BREEDING

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Influence of sow management and nutrition on the number of weaned piglets and meat production

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Abstract. The normal evolution of the puerperium in sows is influenced by the quality of nutrition, microclimate factors in the housing, movement, and pathogens, which have a major impact on the production performance of sows and piglets and on reproductive indicators by increasing the number of non-productive days because of the absence of oestrus. Integrated management allows farms to adapt their production to market needs and consumer preferences by controlling the nutrition of lactating and pregnant sows to maintain body condition and production constancy, ensuring fat reserves from the perspective of microclimate factors and energy consumption for the full expression of the genetic value of sows, the manifestation of heat throughout the whole period of the year, the reduction of non-productive days, and the increase of individual piglet productions. For an efficient meat production and for quick possibilities to adapt the flows of obtaining meat to the needs of the market, it is necessary to follow, along the meat chain, the reduction of the service period, the improvement of the reproduction management in sows, the increase of the number of piglets per sow by reducing the number of non-productive days, the feeding of sows according to physiological conditions, and the control of microclimate factors to ensure animal welfare.

Keywords: sows, nutrition, management status, piglets, meat

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Introduction.

The Puerperium is among the most important stages in the productive life of sows; its control by implementing in farms the best management of the exploitation of sows with piglets contributes to the normal evolution of the genital tract of the sow, and the achievement of good milk production, which contributes to the normal development of piglets (Farmer C and Edwards SA, 2020) and the reduction of non-productive days if the management measures foresee a control of nutrition (Huting AMS et al., 2021), maintenance, and microclimate. Professional farms that have an integrated management of meat production manage to maintain: a normal involution of the genital tract by reducing the pathogens affecting the genital tract and delaying the normal development of oestrus after piglets are weaned (Katsuda K et al., 2006; Fé Rodríguez PV et al., 2013); a microclimate corresponding to the category and physiological state of the sow and the age of the piglets; a condition that ensures the production of milk in economic condi-

tions, from the discretionary feeding of the sow in puerperium and not from its own reserves accumulated during gestation, which changes the status condition and increases the number of non-productive days, because the sows must restore body mass after weaning, not being ready for a new reproductive cycle (FEEDAP et al., 2023a; FEEDAP et al., 2023b; Chitakasempornkul K et al., 2019; Gonzalez-Ramiro H et al., 2023; Huzău G et al., 2021; Kaur S et al., 2021; Roese G and Taylor G, 2006; Theil PK et al., 2022; Wang L et al., 2022; Xu S et al., 2022).

Obtaining good individual productions of piglets and increased quantities of meat can only be achieved if, through implemented farm management, sow puerperium and life conditions of sows, piglets, and fattening pigs are ensured for the expression of the economic capacity of:

- the genetic value of the biological material;
- oestrus in sows throughout the year;
- to reduce the number of non-productive days in sows;
- nutrition and microclimate control.

Controlling the reproductive function of sows to increase meat production according to consumer requirements is determined by a multitude of factors, but the reproductive cycle influences the general condition of sows, the manifestation of heat after puerperium, and future meat production. The analysis of the influencing factors of the reproductive function in sows is the object of scientific research in search of solutions to improve the management of pigs for meat production (Chitakasempornkul K et al., 2019).

The conclusions of research in the field suggest that all reproductive components influence the adaptability of farms to the meat market trend, the solutions being:

- Reducing heat stress that has effects on (Roese G and Taylor G, 2006):
 - a) the preparation of the genital tract in a short time for a new pregnancy;
 - b) milk production with effects on piglet weaning weight;
 - c) normal cycles after weaning piglets at 21-23 days;
- Modification of nutritional systems by (Gondret F et al., 2020):
 - a) ad libitum feeding of sows;
 - b) wet fodder;
 - c) balancing the rations with lactogenic substances to the detriment of the consumption of own reserves;
- Implementation of puerperium management with:
 - a) milk production control;
 - b) appropriate microclimate to avoid fat deposits in the carcasses;
 - c) stimulation of early consumption of feed with a high degree of digestibility to achieve high average daily gains;
 - d) use of production systems that can easily adapt to the trend of the meat market;
 - e) use of biotechnologies for the induction of oestrus in lactation;
- Automation of maternity activities through:
 - a) health control of sows and future fattening pigs;
 - b) automation of all farm activities;
 - c) automatic regulation of the microclimate;
 - d) ensuring the well-being of fattened pigs;
 - e) maintaining the biosecurity of industrial breeding and fattening farms through good prevention practices.

Because the temperature in the shelters has an influence on the amount of feed ingested and the quality of the meat obtained from piglets that were not provided with prophylactic conditions, inadequate microclimate causes the occurrence of cold diseases, a day of illness in piglets causing the extension of the fattening period by three days and higher amounts of fat in carcasses and feed conversion indices (Mou Q et al., 2019; Sampath V et al., 2020). To meet market demand and allow farms to adapt their production, they must find solutions to increase individual sow productions by increasing the number of piglets and economically converting feed into milk to reduce the number of non-productive days after the end of the

puerperium. To reach these objectives, it is necessary for the organizational management of production to find solutions for (Roese G and Taylor G, 2006; Rooney HB et al., 2020a; Rooney HB et al., 2020b):

- the improvement of production systems according to technological sequences, for the rapid adaptation of the farms to the demands of the meat market;
- the use of oestrus induction biotechnologies during the lactation period to obtain larger amounts of meat;
- the stimulation of the sow's feed consumption to reduce the lactation period to 21-23 days and produce piglets with high weaning weights;
- the stimulation of early feed consumption in piglets to achieve high weaning weights and shorten the period of producing meat at the age of 140 days and weights of 100 kg per fat pig;
- the improvement of the productivity of sows by controlling the reform according to the meat production achieved per sow per year (Ball RO et al., 2008; Boyd RD et al., 2002);
- the reduction of non-productive days through hormonal stimulation of the reproductive function (Chitakasempornkul K et al., 2019).

Research objective.

Develop management measures to help farms adapt to meat quantity requirements through implemented technologies and improve reproductive performance of sows by reducing non-productive days.

Materials and methods of research.

The factors that are easiest to control by management regarding the production of sows expressed by the amount of meat obtained per year per animal are: nutrition, optimal development of the lactation period, microclimate, pathogens and well-being in all phases of the technological flow, maternity, youth, and feedlot. Considering these aspects in the case of research undertaken on genetic material performed specialized for obtaining piglets, these factors have been analysed on a professional breeding, growing and fattening farm, with the aim of finding solutions to meet the market demands for a certain type of pork. As a result of analyses, management solutions were developed to contribute to the adaptation of the farms to the demands regarding the quantities of meat through the technologies implemented and the improvement of the reproductive indices in sows by reducing non-productive days.

Results and discussions.

The most difficult period in the sow's life is lactation and the resumption of the reproductive cycle at the end of the puerperium, as it contributes to the constant supply of the market with meat obtained from weaned piglets subjected to fattening which allows the rapid adaptation of the farms to the needs of the market by reducing non-productive days and ensuring good health for the quantitative and qualitative requirements of consumers on the pork market.

For an efficient meat production and quick possibilities to adapt meat flows to the needs, it is necessary to follow the following in the meat chain:

1. Reducing the service period and improving reproductive management in sows. The normal development of the production system according to the needs of the meat market involves the control of the sow herd regarding reproductive capacity, age and performance, and the amount of meat per year per sow. Puerperium sows have a certain evolution of productive potential which, after the fifth lactation, begins to decrease in terms of milk production and of the number of fat pigs delivered per sow per year. In order to meet the demands of the meat market, it is necessary to ensure a healthy biological material for fattening with good production performance in terms of feed conversion, gains achieved, and carcass quality obtained (de Vries H and Smidt H, 2020). In addition, for the growth of youth for pork (Vodolazska D et al., 2023), it is necessary that it be obtained constantly, but in both cases, it is necessary to ensure the biological reproduction of sows, and that the interval between farrowing and confirmation of pregnancy be as short as possible within biological limits. This process in intensive pork production is not possible if:

- sows with low performances are not reformed;
- the amount of meat per head of fed sow is not increased;
- healthy youth with good performance for fattening is not ensured.

The importance of the duration of the service period in the industrial reproduction of pigs also results from the perspective of obtaining many piglets per sow and improving the productive potential of sows through selection processes under appropriate technical management conditions. The sowing and calving program staggered according to the market trend is an effective tool in this sense, through it aiming to:

- the biological and physiological evolution of lactating sows waiting for insemination (Baxter EM et al., 2020);
- the state of sows (fat reserves);
- the factors that negatively influence the establishment of reproductive conditions by increasing non-productive days.

Without knowing these indicators, the farmer cannot adapt his production to the needs of meat consumption and consumer preferences, and will face undesirable economic consequences since the efficiency of the farm activity will be affected by the expenses of maintaining the sows while waiting for insemination, with not enough young for fattening or 2.35 litters per year per sow achieved. Depending on the objectives of the operation and the system of relations with the environment (the market), the reproduction management strategy will consist in reducing the service period in:

- the use of the simple reproduction system with the maintenance of the number of fed sows and the replacement of removals by reformation with sows;
- the use of the extended reproduction system by increasing the herds in periods when the market demands large quantities of meat.

Achieving the objectives is aimed at controlling the biological capacity of sows and at implementing the most effective reproductive management through the control of reformation, non-productive days, nutrition, maintenance and microclimate. Production forecasting involves strategic management measures to organize reproduction according to the evolution of the meat market and aims to control:

- the reproduction stock;
- the replacement sows and the increase of meat production in certain periods;
- the youth intended for fattening;
- the production performance of fattened pigs;
- the quality of carcasses and meat.

In the case of the exploitation of many sows, the problems of reproduction are more complex, in the sense that each animal must be monitored to know its physiological state, which requires the existence of an information system, but the reduction of the service period has a primary role. The improvement of reproduction management, the evolution of the sow herd has as a major effect the organisation of insemination and farrowing in continuous flow, obtaining the necessary products for fattening and meat throughout the year. The rhythmicity of production, based on market studies, has positive effects on:

- the economy of the integrated pig farm;
- the efficient use of capital and human resources;
- the income, provided that the production and processing management system is observed;
- the competitive prices for selling youth and meat.

In order to shorten the service period and reduce non-productive days, several measures are required regarding:

- the seeding forecasting;
- the pair matching programming according to:
 - a) the reproductive capacity of sows;
 - b) the reproduction technology;
 - c) the financial possibilities of the farm;
- the intensification of reproduction by stimulating the reproductive function:
 - a) the stimulation of oestrus in lactation;
 - b) the staggering of farrowing by increasing the herd;
 - c) the nutrition control;
- the orientation of exploitation towards sows with high productive potential:
 - a) the reduction of the service period;
 - b) the increase of the degree of adaptability to industrial exploitation;

c) the maintenance of a herd structure with 3-4 litters when the best reproductive indicators are achieved: low embryonic mortality, fecundity, birth rate, prolificacy, and high number of weaned piglets.

2. Increasing the number of piglets per sow by reducing non-productive days. Farm management, technological conditions of operation, and hybrid type of breeding sows have a major impact on the productive life span of breeding females, with a large genetic variation between breeds and the system of operation. There are many factors with an impact on the duration of the productive life of sows, and the ways to improve them are the following types of management:

- integrated farm management;
- management of selective breeding practices;
- management of reproduction of maternal breeds;
- management of reproduction systems.

For the analysis of the productive capacity of sows, the duration of the productive life, the time-dependent effect of the interaction farm – year of production (which explains the largest proportion of variation in the duration of the productive life through significant associations between the interaction year – farm), and productive longevity of sows should be considered.

In the Table 1 are presented the number of non-productive days in weaned sows during spring and summer and the necessary management measures.

Table 1. The number of non-productive days in weaned sows

Month	at 22 days	at 25 days	at 28 days	Management measures
March	40±1.8	42.5±1.75	38.4±1.75	the use in the feeding of lactating sows of quality fodder and in sufficient quantities administered in wet form; weaning of sows at 22-25 days; stimulating the manifestation of heat through hormonal treatments; feeding with estrogen-rich fodder during the waiting period for insemination; increasing the protein level by 2.2% of the feed administered during the waiting period for artificial insemination.
April	39.6±2.0	43.02±2.6	41.2±1.5	
May	39.7±2.8	44.5±2.8	42.5±2.2	
June	41.0±2.2	41.8±1.5	40.4±2.4	increasing the useful surface per weaned sow; diversifying the diet of weaned sows, introducing 1.00 kg of estrogenic green fodder (alfalfa or clover) into the ration; accommodation of waiting sows near farrowings if any; the use of biostimulators with the smell of testosterone; sound stimulation of sows with onomatopoeia of boars; • increasing the number of inseminaries from 2 to 3.
July	40.6±1.5	42.0±1.0	40.2±2.5	
August	40.7±2.0	42.0±0.8	41.5±1.6	
September	38.0±1.2	39.5±1.5	39.4±1.8	- nutritional stimulation of lactating sows; - increasing the amount of protein in the ration while waiting for sowing; - increasing the number of sowings; - intensification of heat detection; - increasing the reform percentage, by replacing multiparous sows with gilts.
October	37.6±2.2	39.0±2.0	40.4±2.0	
November	37.5±1.0	38.8±1.0	41.0±1.4	
December	36.6±2.0	37.5±1.7	38.2±1.8	- diversification of fodder rations by using alfalfa flour or briquettes; - hormonal stimulation of hot flashes; - increasing the replacement rate of multiparous sows with gilts; - increasing the lighting duration of the shelter.
January	35.8±1.4	38.2±1.9	39.5±0.8	
February	36.0±1.8	39.0±1.3	39.4±1.3	

The impact of farm – year environmental effects on productive life span is evident because farms have different slaughter policies and other management practices differ between farms. Moreover, the researchers' impression is that the farm – year effect also explains the management and factors related to the farm's assets, contributing to health and reproductive problems. This is suggested because reproductive failure and foot health are the most identified reasons for involuntary culling of sows and because variation in farm conditions and management is relatively high.

To extend the life of sows and increase the amount of meat per sow, attention should be focused on: sow reproduction management, farm facilities to optimize the duration of productive life and the association of age at first calving and length of productive life. This indicates that sows that conceive at first insemination appear to have reproductive problems later in life that will shorten their productive life. If the association is due to integrated farm management factors alone, the current results indicate that management should support sows to first farrow at 10 months.

Therefore, the first factors that must be analysed related to the duration of the productive life to ensure the number of animals for fattening and obtaining the predicted amount of meat are the conditions of exploitation of the sows, the control of the puerperium and of the nutrition, the factors that influence the increase in the number of non-productive days, and the type of management of reproduction.

3. Control of nutrition per physiological states in sows. Nutrition has a major influence on how the reproductive tract of the lactating sow develops because of:

- metabolic diseases contribute to reducing the amount of milk in sows;
- low weights and a reduced number of piglets are obtained at weaning;
- oestrus is prolonged after weaning, either because of the condition of the sow or of the improper involution of the genital apparatus.

Nutrition management must propose concrete solutions for resuming the reproductive function of sows and reducing non-productive days by using the following managerial solutions such are:

- maintaining the body condition of the sows during the nursing period by controlling nutrition;
- ensuring the microclimate of maternity farms to maintain the fat reserves of the sows;
- ensuring the necessary energy for the expression of the genetic value in sows regarding lactogenic capacity;
- feeding protein-rich rations to stimulate heat after piglets are weaned;
- balancing the protein-vitamin-mineral rations of lactating sows to stimulate milk production.

Good nutritional management of lactating sows must provide for the maintenance of a balance regarding the amount of ad libitum feed, as undernutrition causes sows to become weak and have reproductive disorders. Too high amounts of feed – overfeeding – also causes in sows:

- a lack or quiet heat;
- a total lack of oestrus;
- the inactivity of the two ovaries;
- a diminution of folliculo-genesis.

The amount of uncontrolled energy produces reproductive imbalances leading to increased non-productive days and silent and anovulatory heats, but the high intake of energy feed in rations leads to:

- sows fattening;
- reduction of the elasticity of the uterine tissue;
- post-partum disorders;
- placental retention;
- lack of milk secretion.

Proteins have a defence, biocatalyst, and plastic role in deficiency causes:

- mobilization of muscle proteins;
- involution of the reproductive function;
- agalaxia;
- long anoestrus.

Mineral salts cause imbalances such as:

- deficiencies: calcium deficiency causes retention of the foetal appendages; phosphorus deficiency leads to prolonged heat; iodine deficiency causes the formation of follicular cysts; manganese deficiency causes abortions; sodium deficiency causes irregular periods;

- excess: potassium excess causes irregular oestrous cycles; phosphorus excess leads to laborious calving; manganese excess determines the prolongation of the heat; sodium excess causes the occurrence of placental retention.

Vitamins produce in sows: hypovitaminoses cause embryonic mortality while hypervitaminoses cause reproductive disorders.

For intensive production systems, it is not recommended to fatten gestating sows for use of lactation reserves but stimulating lactation feeding when feed is converted to milk. During the waiting period until heat appears, feeding with energy-rich recipes is indicated, as well as nutrition management during pregnancy and the first week of lactation will have to ensure the achievement of an average daily increase of 260-275 g in the last 45 days of gestation when piglets develop the most and 140-150 g in the first week of lactation.

4. Controlling the physiological condition of sows. Inadequate maintenance status, fattening of sows during pregnancy, consumption of own reserves during lactation has negative effects on the constant production of biological material for fattening and does not give the possibility for farms to predict and adapt their production along the entire meat chain according to the demand of consumers on the market due to:

- unbalanced and uncontrolled nutrition quantitatively and qualitatively contributes to the occurrence of disturbances in the neuroendocrine metabolism;

- disturbances regarding reproduction through the installation of some changes in the anterior pituitary gonadotropins regarding the secretion of oxytocin and oestrogen or progesterone, which causes an increase in non-productive days, and waiting for the installation of a new pregnancy after weaning the piglets;

- many lactating sows are exhausted after lactation, show prolonged anoestrus, increase expenses with exploitation, and do not achieve a use index of more than 2.35 parturitions per year.

5. Effects of lack of microclimate factors in shelters. These factors, if not controlled by management measures, have effects on the biological material producing genetic material for fattening because they have major effects on reproductive function. Biological factors are responsible for disturbing the state of welfare of sows, cause the deterioration of the state of well-being, change the condition of sows, and produce mucous membrane irritation and respiratory disorders. Instead, chemical factors increase the incidence of diseases, cause discomfort by showing a state of agitation, decrease milk production by reducing feed consumption, and gregarious behaviour (Prunier A et al., 2020a; Prunier A et al., 2020b).

Uncontrolled physical factors that ensure thermoregulation, the synthesis and release of gonadotropin hormones and the regulation of ovarian function, cause the abnormal development of the puerperium in sows, infections, mamitis, mastitis, and agalaxia syndrome, and the delay in the onset of heat after piglets are weaned.

6. Ensuring the welfare of lactating sows pending insemination and gestation. Ensuring the well-being of the sows has beneficial effects on the piglets and the future production of pork for good conditions ensure the increase of muscle tone, improves blood circulation, and activates the neuroendocrine system and the neurovegetative tone, the biological material being more vigorous and resistant to the conditions of exploitation for meat production. The factors that disrupt the welfare of sows regardless of their physiological state lead to uterine atony, post-partum endometritis, retention of the placenta and foetal membranes, with negative effects on oestrus after weaning and an increase in the number of non-productive days. In order to maintain the genital tract of sows in a good working condition, the managerial measures for the organization of the puerperium and gestation must provide for the control of:

- microclimate factors that ensure the well-being of piglets and sows;

- the nutritional level according to the physiological need and the expected production to be achieved within a certain time interval;

- the necessary amount of energy during the critical periods in the life of sows, lactation, and preparation for insemination;
- early gestation to reduce unproductive days;
- the quantities of feed administered per month of gestation to reduce embryonic and foetal mortality;
- the conditions provided by integrated management to ensure the biosecurity of the biological material;
- the operating conditions for the manifestation of the productive parameters of the biological material at its biological value.

Conclusion.

The measures imposed by the integrated management allow farms specialized in pork production to adapt their production to market demand and consumer preferences by controlling the nutrition of sows to maintain body condition, to ensure energy reserves and the constancy of the production of piglets destined for fattening.

Balanced nutrition based on physiological state according to the needs of sows and piglets influences the way the puerperium evolves because the incidence of metabolic diseases contributes to the failure of predicted results according to the biological value of the exploited genetic material because of technological mistakes.

It is recommended to feed the sows in a controlled way during the months of gestation depending on the level of development of the piglets, avoiding fattening them and ad libitum during lactation, ensuring water in the necessary quantities for the normal development of the puerperium, reducing non-productive days by exhausting sows (using their own reserves for milk production) and obtaining many piglets with high weaning weights.

Ensuring a suitable state condition through managerial measures contributes to the reduction of non-productive days per sow and contributes to obtaining high meat productions because the implementation of the best nutrition management for sows in physiological conditions ensures a genetic healthy fattening material with a high feed assimilation, and their transformation into meat during the fattening period.

Failure to ensure the farm's biosecurity, inadequate welfare conditions, and failure to control microclimate factors lead to the non-achievement of planned productions and to putting the farms in difficulty because they cannot adapt to the competition and the preferential demand for meat from consumers on the market.

Only the feeding of sows per physiological condition and the stimulation of piglets, the early consumption of feed with the control of microclimate factors, with healthy animals introduced for fattening, with welfare and biosecurity conditions are the key elements that ensure performance on the farm and make farms adaptable to market demand without great

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