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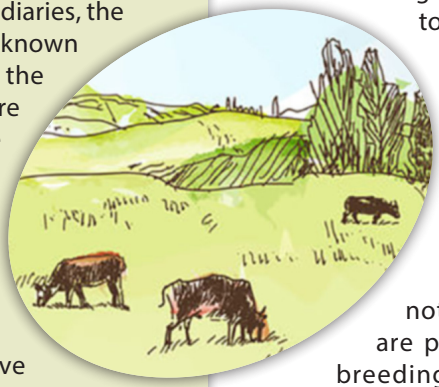
Fetal Bovine Serum and the Slaughter of Pregnant Cows: Animal Welfare and Ethics

By Ole Bødtker Nielsen and Percy W. Hawkes

Abstract

This article examines two interrelated animal welfare topics: the transportation of pregnant cattle, and the collection of fetal bovine serum (FBS). The occurrence of pregnant cattle at slaughter is unavoidable because of health, management, and economic reasons, or because farmers may be unaware of their pregnancy status. Since cattle are often sold to slaughterhouses through intermediaries, the pregnancy status of the cow is usually unknown until after it has been slaughtered and the uterus exposed. In slaughterhouses where fetal blood is collected, technicians are responsible for the detection and proper handling of fetuses, making sure they remain inside the uterus until dead, or are immediately euthanized. The harvesting of fetal blood also provides a possible source of information, which upon request, may help farmers improve the management of their livestock operations. The serum industry endorses the animal welfare standards set forth by the World Organization for Animal Health (OIE), as well as all existing local and national standards relating to the transportation of pregnant cattle and the collection of fetal blood. This article concludes that there is nothing negative or unethical about collecting blood from a dead fetus. Rather it would be unethical not to utilize available fetal tissues obtained from the slaughter of pregnant cattle, especially since FBS, used as an ingredient in cell culture media, contributes greatly to the advancement of the life sciences industry, as well as the replacement and reduction of live animals used in research and testing.



1. Introduction

Within some research and animal welfare circles, there are misconceptions about how fetal bovine serum (FBS) is collected in slaughterhouses, as suggested by van der Valk in a recent *Altex Journal* article.[1] One of the erroneous beliefs is that fetal blood is collected from live fetuses. At the same time, there are other misunderstandings relating to the slaughter of pregnant cows. A recent May 2017 report from the European Food Safety Authority (EFSA) panel on Animal Health and Welfare (AWAH), published in the *EFSA Journal*[2] examines issues surrounding the slaughter of pregnant farmed animals in the European Union (EU). The panel's report estimates how many pregnant animals are slaughtered, gives the reasons why they are slaughtered, and discusses whether bovine fetuses in the last trimester of gestation can experience pain. The EFSA report contributes to an improved understanding of the slaughtering of pregnant animals and how it relates to animal welfare.

The following article makes the connection with the slaughter of pregnant cattle to the ethical aspects of harvesting FBS used in the life sciences.

2. Occurrence of Pregnant Animals at Slaughter

According to EFSA's report[2], farmers may not be aware that animals sent to slaughter are pregnant because of uncontrolled natural breeding, failure to perform pregnancy testing, misdiagnosis of pregnancy, or poor transmission of information to cattle dealers.

A 2014 Swiss study[3] says that pregnant cows may knowingly be sent to slaughter for more than 20 different reasons; among them: poor production, health-related problems, and herd liquidation caused by economic motives. The EFSA report also mentions management advantages, giving as example that pregnant animals tend to be calmer than non-pregnant animals. Another example is the anabolic effect of pregnancy as a part of farmers' production schedules.

The EFSA expert panel asserts that an average of 3% of dairy cows and 1.5% of beef cattle are slaughtered during the third (and last) trimester of gestation, based on a survey of 100 slaughterhouse operators across ten EU member states.[2] The Swiss Federal Office for Food Security and Veterinary Affairs (OSAV) report indicates a similar level; with pregnancies in 70% of cases unknown to the farmer.[3]

3. Cattle Supply Chain and Traceability

Cattle are often sold to the slaughterhouse through intermediaries. In most cases, it is not known that the cow is pregnant until after the cow has been killed and the uterus exposed. Consequently, abattoirs cannot be held responsible for the

state of gestation of the cows, but upon request of the farmer, the abattoir may be able to report the number and size of fetuses whenever fetal blood is harvested. Thus, the harvesting of fetal bovine blood represents a possible source of information which, upon request, may help farmers improve the management of their livestock operations. The EU's animal identification program[4-6] makes possible the collection and transmission of such data back to farmers, provided the link between cow and fetus can be maintained during the slaughtering process (though sometimes difficult in large abattoirs).

4. Does the Fetus Feel Pain?

The World Organization for Animal Health (OIE)[7] and the American Veterinary Medical Association (AVMA)[8] have cited scientific evidence showing that the fetus does not suffer when the cow is slaughtered, as long as the fetus remains inside the uterus for 15–20 minutes, the time it takes for the fetus to die. (See Box #1 and Box #2). The serum industry, both the European Serum Products Association (ESPA) and the International Serum Industry Association (ISIA), endorse the OIE animal welfare standards and the scientific evidence used to support these standards.

In practice, when a fetus is detected at slaughter, the intact uterus with the fetus inside is removed from the carcass and taken to a separate room where care is taken to assure the fetus is not exposed to the outside air. Fetuses exposed to the outside air are immediately stunned and euthanized. The average time elapsed between slaughter of the cow and removal of the fetus from the uterus normally exceeds the OIE minimum standard of 15–20 minutes. A study by the veterinary inspector in a French slaughterhouse[9] reported that the time lapse between the slaughter and removal of the fetus from the intact uterus for harvesting blood was never less than 40 minutes. The study also reported that when removed from the uterus, none of the fetuses showed any vital signs.

Since fetuses are always dead prior to harvesting blood, whether or not they may feel pain, distress, or discomfort beforehand is directly related to the absence or presence of slaughterhouse personnel assigned to the detection, proper handling, and care of fetuses.

As part of their analysis of the transportation of pregnant cows, the EFSA's expert panel also reviewed the scientific information relating to whether fetuses are capable of feeling pain and suffering during the last third of gestation.[2] They arrived at essentially the same conclusions as the OIE[7] and AVMA[8]:

- The third trimester of gestation is when fetuses develop the relevant anatomical and neurological structures needed to feel pain, discomfort, and distress.
- The fetus left inside the intact uterus after slaughter of the cow will remain unconscious and not suffer due to neuro-inhibitors acting on the brain.
- Exposure of the fetus to air, outside of the protective environment of the uterus, will arouse the consciousness of the fetus, who will attempt to breathe air and experience possible discomfort.
- Inside the uterus, death of the fetus occurs from anoxia within 15–20 minutes, according to OIE and AVMA. However, the ESPA took a more conservative stance, recommending the fetus not be removed from the uterus until at least 30 minutes after the cow has been slaughtered.

5. Possible Measures for Reducing the Slaughter of Pregnant Animals

The OIE animal welfare standards recommend not transporting animals during their last 10% of gestation. However, they do not recommend a total mandatory ban on the transportation and slaughter of these animals. Rather, the OIE establishes scientifically based guidelines for the proper handling and care of pregnant cattle and fetuses at slaughter. The OIE member countries (now numbering 182) have given input and guidance

OIE Terrestrial Animal Health Code – Chapter 7.5

Article 7.5.5 Management of foetuses during slaughter of pregnant animals

Under normal circumstances, pregnant animals that would be in the final 10% of their gestation period at the planned time of unloading at the slaughterhouse should be neither transported nor slaughtered. If such an event occurs, an animal handler should ensure that females are handled separately, and the specific procedures described below are applied. In all cases, the welfare of foetuses and dams during slaughter should be safeguarded.

Foetuses should not be removed from the uterus sooner than 5 minutes after the maternal neck or chest cut, to ensure absence of consciousness. A foetal heartbeat will usually still be present and foetal movements may occur at this stage, but these are only a cause for concern if the exposed foetus successfully breathes air.

If a live mature foetus is removed from the uterus, it should be prevented from inflating its lungs and breathing air (e.g., by clamping the trachea).

When uterine, placental or foetal tissues, including foetal blood, are not to be collected as part of the post-slaughter processing of pregnant animals, all foetuses should be left inside the unopened uterus until they are dead. When uterine, placental or foetal tissues are to be collected, where practical, foetuses should not be removed from the uterus until at least 15–20 minutes after the maternal neck or chest cut. If there is any doubt about consciousness, the foetus should be killed with a captive bolt of appropriate size or a blow to the head with a suitable blunt instrument.

The above recommendations do not refer to foetal rescue. Foetal rescue, the practice of attempting to revive foetuses found alive at the evisceration of the dam, should not be attempted during normal commercial slaughter as it may lead to serious welfare complications in the new born animal. These include impaired brain function resulting from oxygen shortage before rescue is completed, compromised breathing and body heat production because of foetal immaturity, and an increased incidence of infections due to a lack of colostrum.

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The European Council (EC) regulation No 1/2005[10] agrees with the OIE standards[7] by recommending that "pregnant females for whom 90% or more of the expected gestation period has already passed" are not fit for transport.

The EFSA panel of experts in animal welfare have proposed the following measures to reduce the number of pregnant animals at slaughter[2]:

- Improved health of animals to reduce slaughter because of sickness
- Management practices (*e.g.*, single sex housing and supervised breeding)
- Gestation records of all animals
- Inclusion of gestation diagnosis in documentation at the time of sale
- Education and communication strategies on preventive measures
- Improved accuracy of rapid on-site gestation testing

The implementation of a total ban on the transportation and slaughter of cattle in the third trimester of gestation would impose additional work at all levels, without any benefit to offset the cost. The legitimate reasons for sending pregnant cattle to slaughter are too many, and enforcement would be nearly impossible. In many cases, it would be impossible to verify the owners of pregnant animals due to problems in maintaining the link between the cow and its fetus. Many other factors, such as determining the exact age of the fetus would make enforcement difficult.

Under hypothetical schemes of "mandatory control", abattoirs would not want to know if a cow presented for slaughter is pregnant. They would most likely not want to be involved in reporting pregnant animals along with the risk of losing the clients being denounced. This in turn would result in: (1) the farmer not receiving feedback about which cows were pregnant; and (2) fetuses not being properly retrieved and handled in slaughterhouses.

We are aware of two countries, Chile and Germany, who have implemented a ban on the transportation and slaughter of pregnant animals. In 2013, Chile implemented a ban on the transportation of livestock in the last 10% of pregnancy.[11] In 2017, Germany implemented a general prohibition of the transportation and slaughter of cattle in the third trimester of pregnancy, but can grant individual exemptions relating to animal health or overriding animal welfare concerns.[12]

It should be noted that other major cattle producing countries, like the United States, Australia, and New Zealand, do not prohibit the transportation and slaughter of pregnant animals.

6. Benefits of Fetal Bovine Serum

Remarkable developments in the life sciences have been made possible because of the availability of FBS and other animal serum collected at slaughterhouses. Cell culture techniques allow the development of life-saving (and sometimes Nobel Prize-winning[13]) medical innovations such as cell, gene, and immune therapies. *In vitro* cell cultures are used in disease diagnostic tests, the development and manufacture of pharmaceutical products and vaccines, and greatly contribute to

AVMA Guidelines for the Euthanasia of Animals: 2013 Edition (page 57)

S3.2.2.6 Dams and Fetuses

Prerequisites for the sensation of pain, distress, or pleasurable experiences are sentience and consciousness. Both are necessary for animals to experience either positive or negative states. Behavioral and EEG evidence indicates that mammalian fetuses are insentient and unconscious throughout the first 75% to 80% of gestation. As neuronal pathways between the cerebral cortex and thalamus become better established, the fetus develops the capacity for sentience. However, while maintained within the protected environment of the animal's uterus it remains in an unconscious state due to the presence of eight or more neuro-inhibitors that act on the cerebral cortex of the fetus to maintain it in the sleep-like state of unconsciousness. At birth, the combined effects of reduced neuro-inhibition and onset of neuro-activation contribute to gradual arousal of the mammalian newborn into a state of consciousness that occurs within minutes to several hours after birth.

These observations indicate that the fetus does not suffer as if drowning in amniotic fluid when the dam is euthanized; nor is it likely to experience pain associated with other types of invasive procedures in utero. These studies also support the rationale for international guidelines on the handling of fetuses suggesting that fetuses should not be removed from the uterus before the EEG is most likely to be isoelectric. For example, when animals are euthanized by physical methods that include exsanguination, delaying removal of the fetus from the uterus for a minimum of 5 minutes after hemorrhaging has ceased generally assures a substantial amount of anoxia-induced damage to the cerebral cortex that will normally prevent progression toward a return to sensibility. If there is any doubt as to the fetus's level of consciousness, it should be euthanized immediately by captive bolt and adjunctive methods as appropriate.

The unconscious state of the fetus also addresses the welfare concerns of those who fear that the collection of tissues (in particular, fetal calf blood by intra-cardiac puncture) from live fetuses in the immediate post slaughter period creates undue suffering. Although the heart may continue to beat (which is necessary for the successful collection of fetal blood), in the absence of breathing there is little likelihood of return to a state of consciousness. These are by no means insignificant concerns as there is high demand for fetal tissues to support laboratory research. A 2002 report suggests that world demand for fetal calf serum was 500,000 L/y and growing, a need that would require the harvest of at least 1,000,000 fetuses/y.

The information derived from these observations also has application for fetal rescue situations that may involve euthanasia of late-term pregnant dams by physical methods. The reason why one might attempt this is to avoid remains disposal complications from drug residues as would occur if the fetus were to be delivered by caesarian section using standard surgical methods. Although respiration is interrupted, the heart continues to beat in animals rendered unconscious using physical methods. Therefore, it may be possible to rescue a fetus from an unconscious dam by caesarian section if the procedure can be performed before the fetus suffers irreversible effects of anoxia. Once the fetus is successfully delivered, euthanasia of the dam may be confirmed via any of the previously described adjunctive methods. It is important to understand that there are significant risks to fetal welfare if rescue is attempted. Welfare complications associated with fetal rescue attempts would include impaired brain function caused by anoxia occurring during the rescue attempt, compromised respiratory function and body heat production resulting from fetal immaturity, and greater risk of infection as a consequence of failure of passive transfer of immunity. When the value of the fetus justifies the effort to secure a successful live delivery, the preferred approach to assure fetal health and welfare is by caesarian section using standard surgical procedures.

replacing and reducing the use of live animals for research. As noted by van der Valk *et al.* in 2010[14], the global demand for FBS has increased over the last decades, not only because of the continual growth of the biotechnological and pharmaceutical industries, but because of the lack of better-defined media alternatives.

Serum collected at slaughterhouses is valuable, unique and vital for the life sciences. It should be emphasized that animal serum, especially FBS, has made tremendous contributions to human and animal health, as an ingredient in cell culture media, which goes far beyond the food chain value of the animals which are slaughtered and processed for meat.

7. Ethical Considerations

Collecting fetal tissues at slaughter from a dead fetus is no different than harvesting tissues and organs for medical purposes from food animals slaughtered for their meat. Frequently, arguments for restricting the slaughter of pregnant animals may only be based on sentimental motives without taking into consideration the following points:

- The slaughter of a small number of pregnant cows is an inherent, unavoidable part of meat and milk production.
- Once a cow is slaughtered, the fetus inevitably will die.
- The unnecessary suffering of fetuses in slaughterhouses is avoided when they are retrieved and properly handled by serum industry technicians.
- The fetus is dead at the time the blood is harvested.

The fetus dies from the lack of oxygen by remaining in the protective environment of the uterus for a minimum of 15–20 minutes after the cow is dead. The animal welfare aspects of handling of fetuses at slaughter are supervised by both the veterinary health authorities present in the slaughterhouses and the serum companies.

8. Conclusion

There is nothing negative or unethical about the process of collecting blood from a dead fetus. The FBS industry endorses the animal welfare standards which require that the extraction of fetal blood be carried out only after the death of the fetus from anoxia while still within the uterus or following stunning and euthanasia.

From an ethical perspective, it is preferable to utilize tissues and derivatives obtained from fetuses rather than allowing them to go to waste. Our society has a moral and ethical obligation to: (1) assure that fetuses are properly retrieved and handled at slaughter; and (2) utilize all by-products available from the slaughter process in the most efficient and responsible manner. The production of FBS for furthering research needed to improve human and animal health is one of the most notable methods of achieving this goal.

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Competing Interests

Ole Bødtker Nielsen is the current President of the ESPA and CEO of Biowest. Percy William Hawkes has been doing consulting work for Biowest for the last 13 years. This article has been written as part of Dr. Hawkes' fee-basis work for Biowest and declares that there are no other competing interests.

About the Authors

Ole Bødtker Nielsen, MSc, is the President of the European Serum Products Association (ESPA), Brussels, Belgium, and Chief Executive Officer of Biowest, Nuaillé, France.

Percy W. Hawkes, DVM*, is an independent Animal Health Regulatory Affairs Consultant, Hawkes Consulting LLC, Payson, Utah, USA. **Corresponding Author*
Email: percywhawkes@hotmail.com | Phone: 1-801-919-9082