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Popular Article

The Red Resource: Transforming Slaughterhouse Blood into High-Value Products

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Abstract:

Slaughterhouse blood is one of the most underutilized by-products of the meat industry and its improper disposal can create a considerable environmental burden because of its high organic load. At the same time, blood contains valuable proteins, haemoglobin, iron and other biologically active components that can be recovered for food, nutrition, nutraceutical, pharmaceutical and biotechnology applications. Separation of plasma and cellular fractions, protein hydrolysis and recovery of bioactive peptides provide opportunities for converting this by-product into value-added ingredients and functional products. Haemoglobin and its hydrolysis products are also being explored for their nutritional and functional potential. However, rapid coagulation, microbial contamination, intense colour, undesirable flavour, oxidation, regulatory requirements and processing costs can limit wider utilization. Improved processing and integrated recovery systems could help overcome these limitations and transform slaughterhouse blood from an environmental liability into a valuable resource, contributing to resource efficiency and a more circular and sustainable meat industry.

Keywords: slaughterhouse blood, haemoglobin, blood proteins, bioactive peptides, valorization, meat by-products, circular bioeconomy

Introduction:

Meat processing generates several by-products, including blood, bones, skin, fat and visceral tissues. Their efficient utilization can improve resource efficiency and reduce the environmental impact of meat production. Blood is particularly important because it combines high biological value with considerable pollution potential when improperly managed.

Rather than being treated only as a waste material, blood can be considered a source of proteins, iron and other biologically useful compounds. Recovery of these components provides an opportunity to create value from a material that would otherwise require disposal.

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Blood as a Valuable Resource:

Blood consists mainly of plasma and cellular fractions. Plasma contains proteins such as albumin, globulins and fibrinogen, whereas the cellular fraction is rich in haemoglobin. These components differ in their nutritional and functional properties and can therefore be directed towards different applications.

Plasma proteins possess useful properties such as water binding, emulsification and gel formation. Haemoglobin provides a concentrated protein and heme-iron source, while blood proteins can be hydrolysed to produce smaller peptides with potentially useful biological activities.

Table 1. Major components of slaughterhouse blood and their potential applications

Blood Component	Major characteristics	Potential applications
<i>Plasma proteins</i>	Albumin, globulins and fibrinogen	Food ingredients, binders and emulsifiers
<i>Haemoglobin</i>	Protein-rich and associated with heme iron	Iron-rich ingredients and protein hydrolysates
<i>Blood proteins</i>	Rich source of amino acids	Food and feed applications
<i>Protein hydrolysates</i>	Smaller peptides generated through hydrolysis	Antioxidant, antimicrobial and other functional applications
<i>Heme iron</i>	Nutritionally important iron fraction	Nutritional applications
<i>Blood-derived peptides</i>	Diverse biological activities	Functional, nutraceutical and pharmaceutical research

Processing Slaughterhouse Blood:

Blood must be collected hygienically and processed rapidly because it coagulates quickly and is highly susceptible to microbial contamination. Rapid cooling and appropriate stabilization are therefore important for maintaining its quality.

After collection, blood can be separated into plasma and cellular fractions. This allows each fraction to be processed according to its composition and intended use. Plasma can be used for protein recovery, while the cellular fraction provides haemoglobin. Such fractionation improves the utilization of the available raw material and supports the recovery of multiple products from blood (Gupta et al., 2024)

Valuable Blood Components:

Enzymatic hydrolysis is an important approach for increasing the value of blood proteins. Proteolytic enzymes break larger proteins into smaller peptides, some of which may exhibit antioxidant, antimicrobial, antihypertensive and other biological activities. These peptides have potential applications in functional foods, nutraceuticals and other health-related products (Zaky et al., 2022).

Haemoglobin is another important component because of its high protein content and association with heme iron. However, its intense colour and characteristic flavour can limit its direct use in foods, while heme-associated components may contribute to oxidation. Recent approaches therefore focus on

decolourization, flavour improvement and enzymatic treatment to improve the value and usability of haemoglobin and its hydrolysates (Cheng et al., 2024).

Blood proteins are also becoming a source for targeted peptide discovery. Statistical and machine-learning approaches combined with experimental screening have been used to identify antimicrobial peptides from calf cruor hydrolysates, demonstrating the potential of computational approaches for identifying specific functional peptides (Sanchez-Reinoso et al., 2025).

Uses of Blood-Derived Products:

Blood-derived proteins have potential in food applications because of their functional properties. Plasma proteins can contribute to binding, emulsification and gel formation, while hydrolysed proteins may provide peptides with biological activities.

Beyond food, blood-derived proteins and peptides are being investigated for nutraceutical, pharmaceutical and biomedical applications. Animal-derived bioactive peptides have demonstrated activities such as antibacterial and antioxidant effects, with research increasingly focusing on their preparation, isolation, purification and structural characterization (Sun et al., 2025).

Animal blood products are also being explored for biomedical and disease-related applications, reflecting the broader potential of blood-derived materials beyond conventional food uses (Cao et al., 2025).

Value Addition:

Value addition involves recovering useful components from blood instead of treating it as a single waste stream. Plasma proteins, haemoglobin and protein-derived peptides can be separated and processed according to their properties and intended applications.

This approach is consistent with the broader biorefinery concept, in which animal by-products are processed into safe and useful products rather than being discarded. Integrated utilization can improve resource efficiency and create additional value for the meat industry (Woodgate, 2023).

For slaughterhouse blood, the emphasis should therefore be on efficient recovery, appropriate processing and the development of products with clear nutritional, functional or industrial value.

Challenges:

The major challenge is maintaining blood quality from collection to the final product. Rapid coagulation and microbial contamination require prompt hygienic collection, stabilization and cooling. Haemoglobin can cause strong colour, undesirable flavour and oxidative instability, limiting some food applications. Safety requirements, regulatory approval and processing costs can further restrict commercial adoption. Economical processing methods that maintain safety and product quality are therefore essential.

Future Directions:

Future work should focus on improving the recovery of specific blood components through efficient separation, enzymatic processing and purification. Developing cost-effective processing systems and integrating them into meat-processing operations could increase product value while reducing waste and improving resource utilization.

Conclusion:

Slaughterhouse blood is more than a waste stream; it is a valuable source of proteins, haemoglobin, iron and bioactive peptides. Advances in fractionation, hydrolysis and peptide recovery are expanding its potential in food, nutrition, nutraceutical and biomedical applications. Addressing safety, sensory limitations and processing costs will be essential for wider utilization. Efficient blood recovery can ultimately create additional value while supporting a more sustainable and circular meat industry.

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