

NUTRITIONALLY RELEVANT ENVIRONMENTAL ENRICHMENT TO REDUCE NEGATIVE BEHAVIOUR IN PIGS

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Abstract

Pigs are among the most intelligent and curious farm animals, with a strong natural drive to explore, root, and chew. In modern housing systems, these needs are often restricted, which can lead to boredom, stress, and harmful behaviours such as tail biting or aggression. In the European Union and many other regions, farmers are legally required to provide pigs with enrichment materials. Enrichment improves animal welfare by providing pigs with opportunities to explore and interact. It reduces stress and boredom, allowing pigs to be active, supports natural behaviour such as biting and exploring and prevents undesirable behaviour. Psychological well-being also affects physical health and immunity, which in turn increases productivity; satisfied pigs grow better and have better condition.

There are many ways to enrich pig housing. The most effective options are natural, destructible, and chewable materials, such as straw, hay, or silage. Other materials include wooden blocks, ropes, or chains with objects, balls or toys. Enrichment materials should meet one or more of the following qualities: chewable, investigable, manipulable and edible or feed-like. To be effective, enrichment should be safe, accessible to all pigs in the group, and renewed regularly to prevent boredom. It should also be adapted to different age groups, since piglets, growing pigs, and sows have slightly different needs.

The use of toys should positively affect the welfare and behaviour of pigs and meet the requirements of legislation, while not increasing the complexity of work tasks for staff. In slatted housing systems, suitable methods of environmental enrichment include toys or interactive objects specifically designed for this type of housing, which encourage pig activity and curiosity and do not cause problems related to floor type and manure removal. Based on the above-mentioned properties, a functional prototype of a toy was designed for pigs in the first phase of fattening in slatted housing. It is a compact toy made of natural materials that can be hung in the pen. The toy is explorable, chewable, olfactory attractive and edible. Its use should increase pig welfare, enable the expression of natural behaviour and simultaneously supplement animal nutrition.

Key words: Pig behaviour; environmental enrichment; welfare; aggression; nutrition

Pigs are very intelligent and active animals that spend most of their time in their natural environment searching for food and exploring their surroundings. However, hunger is not the only motivation, as this behaviour also occurs in semi-natural environments when pigs are fed ad libitum (Stolba and Wood-Gush, 1989). A lack of stimuli and severely limited space in intensive farming systems lead to stress and inappropriate stereotypical behaviour, manifested by aggression and the biting of tails, ears or other body parts of

animals within the group. The possible solution is to stimulate pigs through appropriate environmental enrichment, which improves welfare levels and reduces the risk of negative behavioural manifestations. Pigs kept in enriched housing react less aggressively to changes in their environment and are less nervous and fearful, which facilitates animal handling (Pearce and Paterson, 1993; de Jong et al., 2000; Tonepohl et al., 2012). Therefore, it is important to provide pigs with a sufficient amount of suitable materials

that allow them to satisfy their innate need to explore, root, bite and manipulate materials.

According to current European legislation, conditions should be created on farms that meet the ethological needs of pigs, or appropriate measures should be taken to improve their living conditions. Council Directive 2008/120/EC of 18 December 2008 lays down minimum standards for the protection of pigs and emphasises the importance of allowing pigs to express natural behaviour in order to ensure an adequate level of welfare on pig farms. Commission Recommendation (EU) 2016/336 of 8 March 2016 provides guidelines aimed at reducing the need for tail docking. Tail docking in piglets should not be carried out routinely, but only in cases where ear or tail injuries have been proven in other pigs. Before resorting to such procedures, other measures must be implemented to prevent the development of behavioural disorders, taking into account environmental conditions and stocking density within the pen. Inappropriate environmental conditions or housing methods should be modified. Reducing stocking density within the pen is considered an important preventive factor, both in docked pigs (Bracke et al., 2013) and undocked pigs (Wallgren et al., 2016). Environmental enrichment plays a crucial role from an early age; however, information is also available regarding its importance at later stages of life. Providing opportunities for exploration and interaction with the environment during rearing leads to easier handling of animals during stressful periods and results in improved carcass quality due to better bone and muscle development at an early age (Tillitson, 2025).

Environmental enrichment for pigs (e.g. bedding, toys, nibbling and scratching objects) significantly affects animal behaviour and overall condition:

- reduces stress and boredom by providing opportunities for activity and engagement;
- prevents abnormal behaviour, such as tail biting, aggression and stereotypical behaviour;

- supports natural behaviour, including rooting, biting and exploration;
- improves health, as psychological well-being positively influences physical health and immunity;
- increases animal performance, leading to improved growth and body condition.

Legislation requires that pigs have constant access to a sufficient quantity of material that enables exploratory and manipulative activities, such as straw, hay, wood, sawdust, compost, peat or a mixture thereof, provided that these materials do not pose a health risk to the animals. Enrichment materials should meet the following criteria:

- **Safe** – for both pigs and stockpersons;
- **Edible or feed-like** – preferably with nutritional benefits;
- **Chewable** – allowing pigs to satisfy their need to chew and explore tastes and smells;
- **Explorable** – enabling pigs to obtain information about the material;
- **Manipulable or deformable** – allowing pigs to change the location, appearance or texture of the material.

Enrichment objects or materials placed in pens retain pigs' interest for a longer period if they possess some, or ideally all, of the above characteristics. Novelty is a key factor in maintaining pigs' interest; therefore, enrichment materials should also be:

- **sustainably interesting** – encouraging exploratory behaviour and being regularly replaced, supplemented or alternated with other materials;
- **accessible** – allowing oral manipulation by all pigs at all times and being positioned at a suitable height to ensure ease of interaction and cleanliness;
- **provided in sufficient quantity** – ensuring access for all pigs and preventing competition;
- **clean and hygienic** – as pigs quickly lose interest in soiled materials and hygiene must not compromise animal health.

A wide range of materials can be used for environmental enrichment in pig farming. Based on their effectiveness, method of presentation and fulfilment of the above criteria, these materials can be divided into three categories: optimal, suboptimal and marginal.

- **Optimal materials** – possess all desired properties and can therefore be used alone, ideally straw, silage, hay and root vegetables, which are both edible and explorable.
- **Suboptimal materials** – possess most, but not all, desired properties (e.g. ropes, cardboard, wooden blocks, silicone, chains, rubber tubes) and should be used in combination with other materials.
- **Materials of marginal interest** – materials that help distract pigs but should not be considered sufficient to meet their basic needs; therefore, optimal or suboptimal materials should also be provided.

The installation of enrichment materials must be carefully planned to ensure long-term interest for pigs while remaining easily accessible, maintainable, replaceable, cost-effective, easy to store and install, and safe for farm personnel (AHDB Pork, 2018). All suspended enrichment should be positioned at the correct height. Studies have shown that objects suspended at eye level are handled more frequently than objects placed on the floor (Blackshaw et al., 1997; Scott et al., 2009). Hanging enrichment also helps maintain pigs' interest for longer periods while keeping the objects clean.

According to Larsen et al. (2018), straw is a highly effective means of reducing the risk of tail biting in fattening pigs. In that study, reducing stocking density alone did not significantly reduce abnormal behaviour. However, in undocked pigs, the combination of straw provision and reduced stocking density lowered the risk of tail biting to the same level as observed in docked pigs. High-quality straw bedding has been reported in numerous studies as an excellent enrichment material (Niemi et al., 2021), meeting all five criteria for effective enrichment. Nevertheless, particularly on farms with fully slatted

floors and slurry management systems, the provision of straw or similar manipulable materials can be challenging. Such enrichment is labour-intensive, complicates pen cleaning and manure removal, may cause problems in slurry systems and increases maintenance costs. In slatted housing systems, suitable enrichment methods primarily include toys made of natural materials (e.g. softwood, rope), feed enrichment in the form of bulky feed, or interactive objects specifically designed for such housing systems that stimulate activity and curiosity in pigs. The use of toys should positively affect pig welfare and behaviour while meeting legislative requirements without increasing workload complexity for farm staff.

Based on the above definitions and parameters, the ideal environmental enrichment for pre-fattening pigs housed on slatted floors is a toy that is attractive, suitable for suspension, manipulable, chewable and ideally edible. On the basis of these characteristics, a functional prototype of a toy for the pre-fattening category was designed. The toy consists of a hanging block placed in the pen by means of a rope or chain, preferably at eye level of the housed piglets. The block is composed of edible raw materials suitable for pig nutrition, including wheat bran, ground limestone, molasses, dried herbs, and a mineral and vitamin supplement. These ingredients are homogenised and pressed into a mould, allowing the toy to be produced in various shapes and sizes. A loop of natural string (jute or sisal) is embedded into the base material to enable suspension.

Food aromas are added to the base material to act as odour attractants. Selected aromas such as vanilla and honey, which are highly attractive to pigs (de Souza et al., 2020), enhance the appeal of the block and encourage nibbling. Molasses further improves palatability. The raw materials serve as a source of fibre and mineral supplementation in the pig diet. Ground limestone is commonly used in feed mixtures to supplement calcium (Ca). The toy also contains an iron supplement, which is essential for the growth and health of piglets and is often insufficiently represented in

standard diets. In addition to iron, the supplement includes selenium, potassium iodide and vitamins, contributing further to nutritional enrichment.

The inclusion of dried herbs allows physiological effects to be exerted through bioactive compounds such as vitamins, minerals, flavonoids and essential oils. These substances can support digestion, strengthen immunity, calm the nervous system, promote relaxation or exert anti-inflammatory effects, all of which are desirable in pigs. The specific effect depends on the herb selected. In this study, lemon balm (*Melissa officinalis*) was chosen, a well-known and easy-to-grow medicinal plant with numerous proven effects. Lemon balm is an aromatic plant from the Lamiaceae family, with essential oils (citral, geraniol) as its primary active constituents. It also contains glycosides, caffeic acid derivatives, flavonoids and triterpenic acids. Lemon balm exhibits mild sedative and antispasmodic effects in vitro and is commonly used in multi-component products to alleviate gastrointestinal disorders, anxiety and psychological conditions in humans. Lemon balm extract is generally well tolerated and associated with few or no adverse effects (LiverTox: Clinical and Research Information on Drug-Induced Liver Injury, 2012). Lemon balm is generally calming, used for insomnia, and has an anti-stress effect, which is a highly desirable effect for which it was chosen as an ingredient in an anti-stress edible toy. Its appetite-supporting effects, as well as antiviral effects, and also the absence of toxic or anti-nutritional substances, make it particularly suitable for use in younger animal categories. Antioxidant effects have also been increasingly recognised, and its bioactive compounds may help animals cope with heat stress while supporting resistance and performance under increasingly stressful environmental conditions, offering a sustainable strategy for climate change adaptation in livestock farming (All About Feed, 2025).

The hanging edible block was tested on weaned piglets. The prototype was suspended in a pen with a slatted floor housing ten piglets with an

average body weight of 9 kg. The block was positioned at eye level, and piglet behaviour and interaction with the toy were observed. The piglets responded positively to the enriched environment. They explored the toy and, thanks to the free hanging, they could manipulate it well. The attractive odour stimulated nibbling behaviour, while the solid consistency of the block ensured durability during handling.

Hanging objects generally have a positive effect on environmental enrichment due to their manipulability; however, this effect is often short-lived. In contrast, edible toys prolong animal interest through combined olfactory and gustatory stimulation, while also providing feed with sensory properties different from standard rations. For potential commercial application, further testing would be required to assess durability, effects on piglet behaviour and performance, and to optimise shape and production processes for large-scale manufacturing.

The designed functional toy can be effectively used in piglet rearing to enrich the environment and enable the expression of natural behaviour. This approach not only fulfils legislative requirements but also enhances physical and psychological well-being, thereby improving productivity. The edible block simultaneously supplements piglet nutrition with essential nutrients such as iron, calcium and selected vitamins. Opportunities for manipulation and nibbling, together with the presence of bioactive compounds, reduce stress levels and may consequently decrease aggression and undesirable behaviour within piglet groups.

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This work was supported by Ministry of Agriculture of the Czech Republic under Grant RO0723 and NAZV QL 25020030.