# EXCENTIAL SELENIUM 4000 OR SELENIZED YEAST?

## Differences, challenges and solutions.

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# The value of selenium in animal nutrition depends on the form and quality, not only on the total dosage in the feed:

- **L-selenomethionine is the only selenium form that can be stored in body proteins, creating a mobilizable selenium reserve.**
- **Excential Selenium 4000 delivers precision:** 100% selenium as pure L-selenomethionine with near-complete digestibility and full batch-to-batch consistency.
- **Selenized yeast has high batch-to-batch variation in L-selenomethionine, and only 80% digestibility.**
- **Proven superior bioavailability:** Across poultry, swine and dairy trials, Excential Selenium 4000 consistently delivers ~50% higher selenium deposition than selenized yeast at equal inclusion levels.
- **Operational and regulatory advantages:** Excential Selenium 4000 has proven stability in premixes, full EU authorization for all species, and a dust-free profile that improves worker safety.

For most nutritionists and purchasers, the discussion on selenium has moved beyond organic versus inorganic—the real question today is **which organic selenium source actually delivers usable L-selenomethionine (L-SeMet) to the animal**. While many products are labelled as "organic selenium," their nutritional value is not defined by total selenium alone, but by the **amount of digestible, bioavailable L-SeMet they truly provide**. Differences in production method and digestibility mean that not all organic selenium sources are nutritionally equivalent. Understanding these differences is essential for precision nutrition, reliable performance outcomes, and effective selenium transfer to eggs, milk, and meat. This paper therefore focuses on the practical and biological question that matters most: which organic selenium source consistently delivers functional L-SeMet in animal nutrition systems.

**Selenium is an essential trace element, involved in many biological functions via its incorporation into selenoenzymes**

In animal nutrition, selenium is commonly added to the feed to ensure a consistent selenium intake that meets the animals' requirement. When considering modern-day high performing animals, optimal trace mineral nutrition is considered key to sustain robustness that allows for high performance and strong immune functioning. Choosing the right form of selenium is key in this process.

# Importance of selenium in animal nutrition

Selenium plays different biological roles in the body. Some of its main functions can be summarized as follows:

- Antioxidant effects: Selenium is incorporated into glutathione peroxidase and thioredoxin reductase, enzymes that reduce reactive oxygen species and protect cell membranes and cellular functions.
- Immune system support: selenium contributes to anti-inflammatory effects, as well as enhancing the animal's ability to respond against viral and bacterial infections.
- Fertility: selenium is known to play a role in improving fertility via reducing oxidative reactions
- Thyroid hormone metabolism: selenium is incorporated into deiodinases, which are enzymes involved in the conversion of thyroxine (T4) into triidothyronine (T3), which is the ‘active’ thyroid hormone. Proper functioning of the thyroid (and in turn good metabolism) depends on the selenium status.

# Inorganic selenium vs L-selenomethionine

Adding selenium to the diet can be in either inorganic (e.g. sodium selenite, sodium selenate) or organic form. It is widely recognized that organic selenium, in the form of L-selenomethionine contributes to a better selenium status compared to inorganic sources. This is mostly due to two reasons:

**1**

Different absorption mechanisms. Inorganic selenium is absorbed via passive diffusion (selenite) or active transport via sulphate transporters (sulphates) while L-selenomethionine follows the same absorption pathways as a regular methionine.

**2**

L-selenomethionine is the only form of selenium that can be incorporated into animal proteins, therefore allowing for a safe 'reserve' of selenium inside the body (Figure 1). Over time, this stored selenium will become available again during the natural protein turnover.

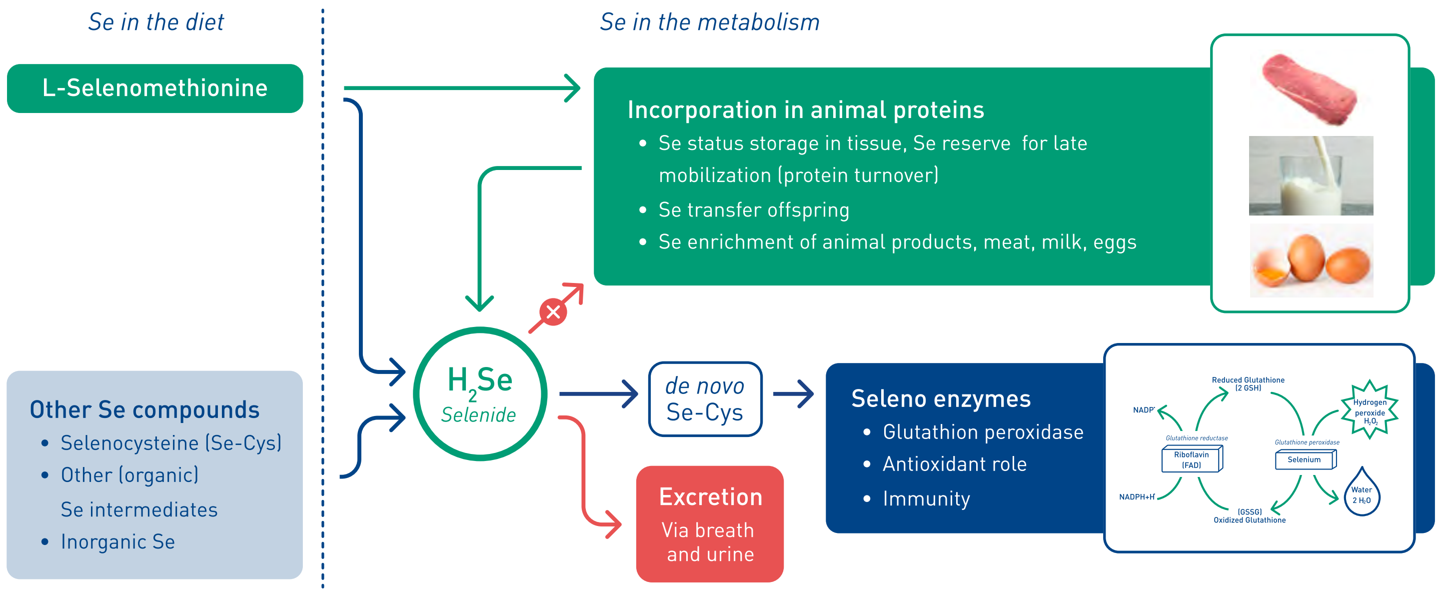
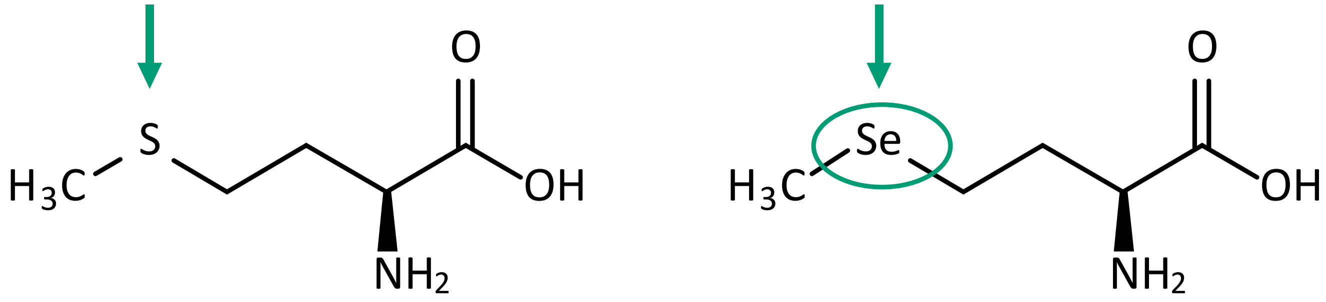



*Figure 1: Selenium in metabolism*

This observation can be explained by the fact that the body cannot distinguish between L-methionine or L-selenomethionine. Therefore, L-selenomethionine can be absorbed and used via the same pathways as L-methionine. Both molecules share the same carbon backbone, but the sulfur present in the molecular structure of methionine is replaced by selenium in the structure of selenomethionine (Figure 2). This allows for random substitution of L-selenomethionine in proteins, causing minimal disruption to the protein structures.



*L-methionine* *L-selenomethionine*

*Figure 2: Molecular structures of L-methionine and L-selenomethionine*

## Incorporation of L-Selenomethionine into proteins : and below no bold what are the benefits?

As mentioned in the previous paragraph, L-selenomethionine is the only selenium source that can be non-specifically incorporated into animal body proteins in place of methionine, forming a natural selenium reserve in muscle and other tissues. This protein-bound selenium can be mobilized during protein turnover, ensuring a continuous selenium supply, for example when feed intake is reduced (heat stress, disease, transport). By maintaining higher and more stable selenium status, L-SeMet supports sustained selenoprotein activity, especially under stress.

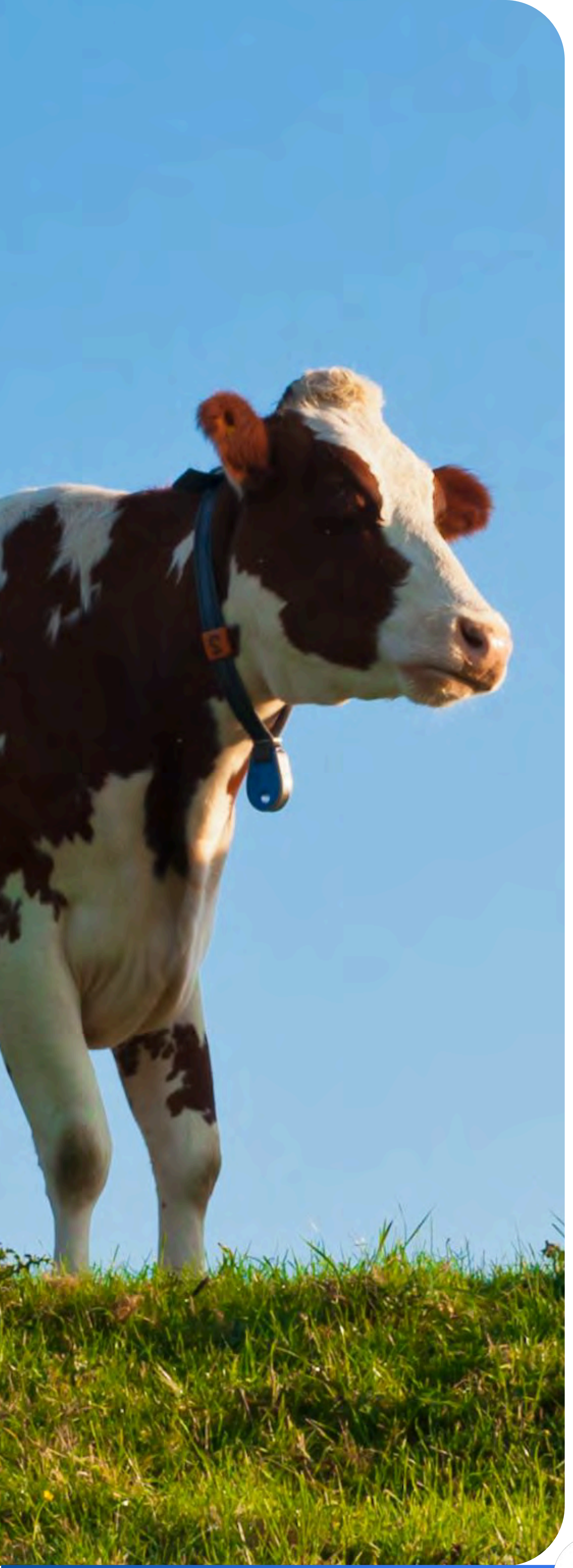
This is reflected in different studies describing higher glutathione peroxidase activity and lower activity of lipid peroxidation markers (e.g. MDA). In practice, this results in:

- Better protection of cell membranes, proteins, and DNA
- Preserving tissue function
- Improved performance

Besides the antioxidant effects, selenium-dependent enzymes regulate:

- Immune cell activation
- Cytokine balance
- Oxidative burst control in neutrophils and macrophages

Therefore, having this stable selenium reserve from L-SeMet ensures immune function is maintained even during transient selenium shortages. This is why L-SeMet is particularly relevant in high-pressure production systems. Benefits of L-SeMet are especially relevant for breeding animals as L-SeMet enables efficient selenium transfer to eggs, milk and offspring, supporting embryo development, neonatal antioxidant protection and early immune competence.



## Consistency and uniformity

Due to the ability of L-selenomethionine to be stored in proteins, the L-selenomethionine content can be seen as major quality indicator for organic selenium products. Excential Selenium 4000 is a product in which all selenium is present as form of L-selenomethionine.

The product is produced via chemical synthesis which ensures batch-to-batch consistency and that all selenium is present in the most effective bioavailable form. This allows for precision nutrition, knowing exactly how much L-selenomethionine you add to the feed.

> L-selenomethionine content can be seen as a major quality indicator for organic selenium products

Another type of organic selenium, which is widely present on the feed market, is selenized yeast. These are products that contain L-selenomethionine but in varying concentrations, which can be explained by
the method of production:

- For production, certain yeast strains (generally *Saccharomyces cerevisiae*) are selected and cultured on a nutrient-rich medium that contains selenium (inorganic).
- This medium supports the growth of the yeast as well as the assimilation of selenium.
- The yeast then converts the inorganic selenium from the medium into different forms of selenium (organic and inorganic), including selenomethionine and selenocysteine.
- Due to the natural production process of selenized yeast, the proportion of total selenium present as L-SeMet is variable.

In various market surveys commercially available selenized yeast samples from multiple producers have been collected and analyzed by an independent lab, for total selenium and selenium present as L-SeMet, using a validated HPLC-ICP-MS method after enzymatic extraction.

- These reviews (Figure 3) demonstrated that there was substantial variation in the levels of L-SeMet between producers, but also between batches.

- Also, despite EU legislation requiring a minimum of 63% of total selenium to be present as L-SeMet, only
  a limited number of commercial batches met this legal threshold.

**The results clearly illustrated large batch-to-batch and supplier-to-supplier variation in L-SeMet levels, confirming that there can be concerns when considering selenized yeast as a uniform or precision selenium source.**

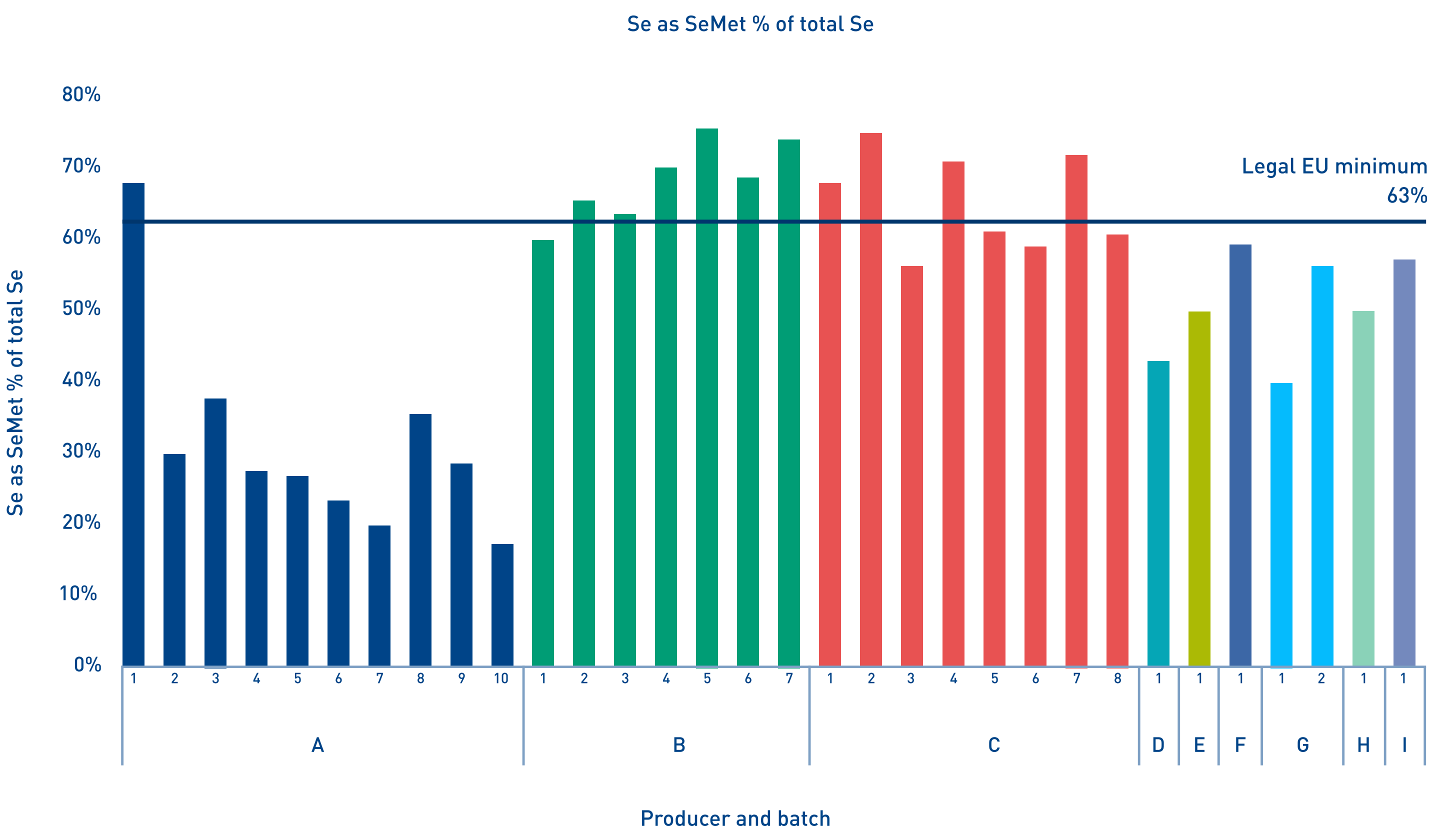



*Figure 3: Commercial sample review of selenized yeast products on Se and L-SeMet levels*

Selenized yeasts contain, in addition to a variable proportion of selenium present as L-selenomethionine, a certain fraction of total selenium in the form of selenocysteine (SeCys). However, the precise quantification of SeCys in selenized yeast is analytically challenging. Over the past few years, several studies have reported SeCys levels in commercial selenized yeast products, but with considerable variation ranging between 2-25%.

Its nutritional relevance warrants further discussion, as dietary SeCys is rapidly converted to selenide within the animal, in a manner comparable to inorganic selenium sources entering the body.

**The nutritional relevance of SeCys in selenized yeast seems to be similar to inorganic selenium**

## Digestibility

Besides the actual content of L-SeMet in an organic selenium product, another important consideration is the availability/ digestibility of the L-SeMet. For pure L-SeMet based products, like Excential Selenium 4000, close to 100% digestibility is assumed across species. This is in line with what is confirmed in literature for L-methionine. As the body does not differentiate between L-methionine and L-selenomethionine, utilization can be considered similar.

For selenized yeast, the pathway in the body is different as the L-SeMet is present inside the yeast protein. This means that first the yeast protein must be digested, split into peptides and amino acids, and then the L-SeMet can be absorbed as a ‘regular’ methionine amino acid in the small intestine. The digestibility of yeast protein is considered to be 70-80%, with reported table values as follows:

- INRA (FR): (brewery yeast, Saccharomyces cerevisiae):
    - Digestibility (SID) methionine for pigs: 69%
- CVB (NL): (brewery yeast, dried):
    - Digestible methionine poultry: 79%
    - Digestible methionine pigs: 80

As the availability of L-SeMet for selenized yeasts depends on the digestibility of the yeast protein, this is assumed to be 80% as well. That means that when a selenized yeast product contains 63% of its Se as L-SeMet (as required by EFSA), there will be 50% digestible L-SeMet in this product (Figure 4).

The pure L-SeMet products, such as Excential Selenium 4000, contain 100% Se as L-SeMet with 100% digestibility, so this product can deliver approximately twice as much digestible L-SeMet (depending on total L-SeMet content of the selenized yeast).

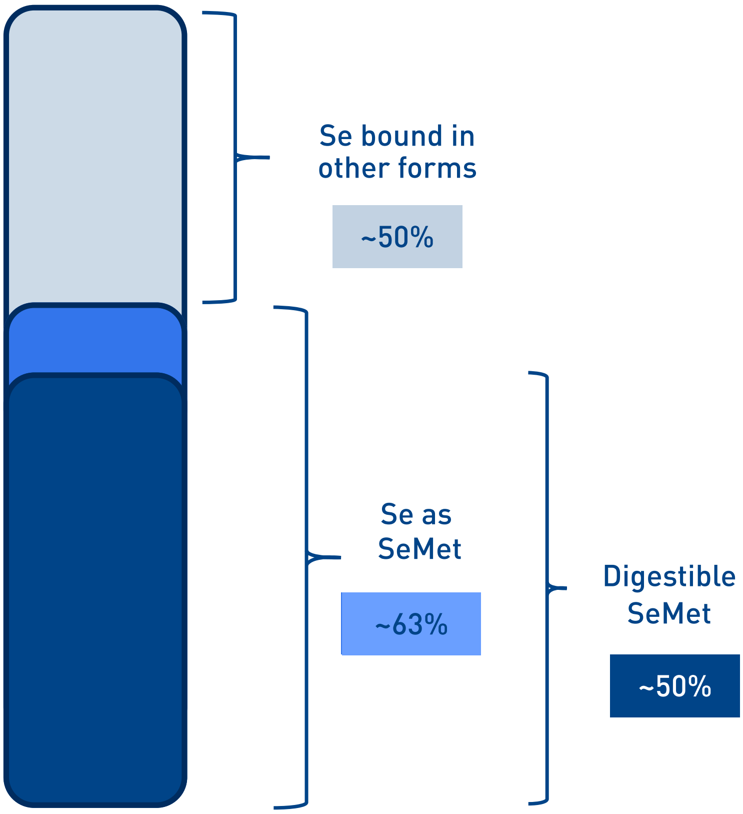
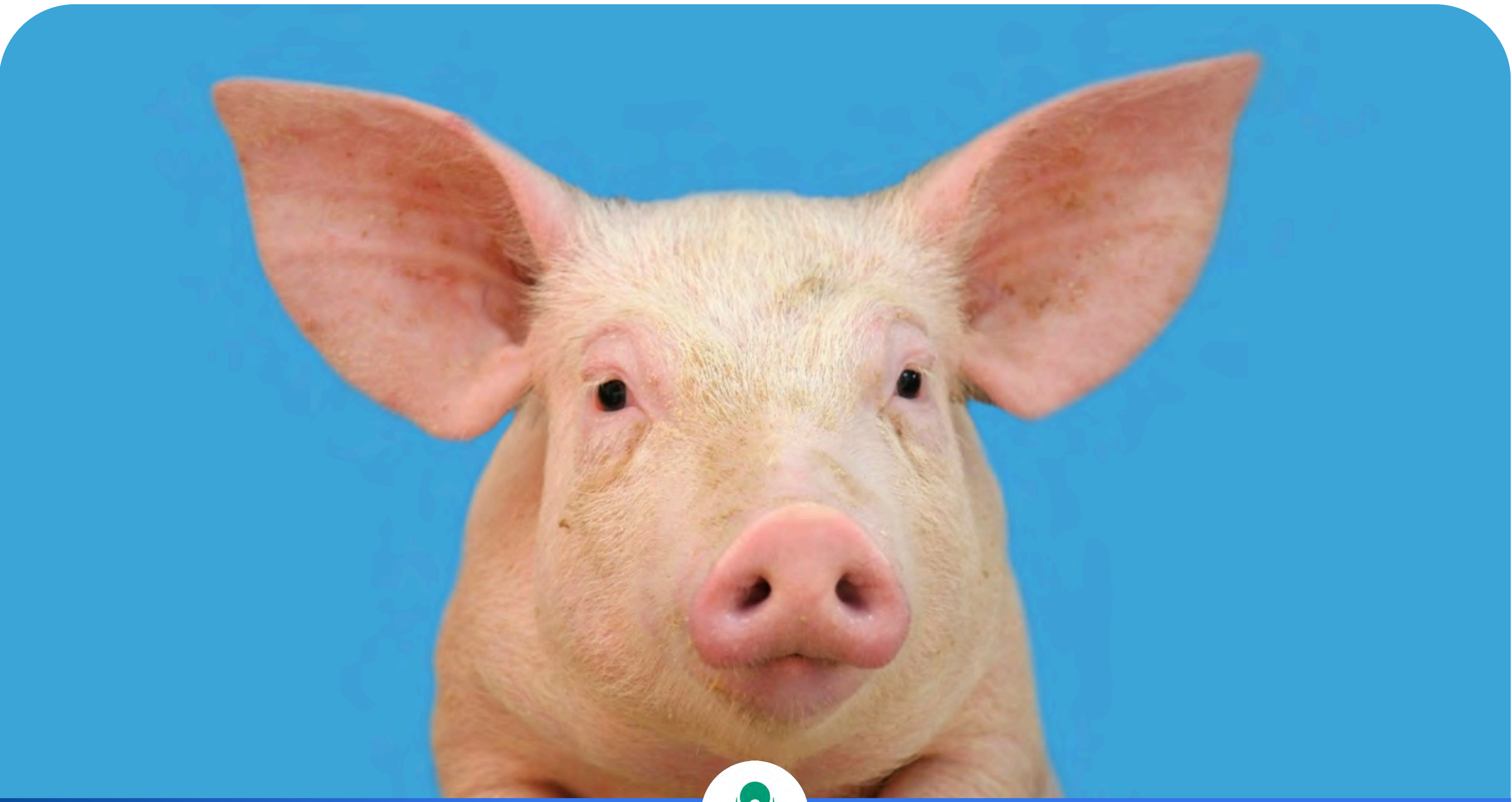



*Figure 4: selenium and L-SeMet content selenized yeast*



# Digestibility

Bioavailability of different selenium sources is confirmed by a wide database of trials. Deposition trials serve as reliable indicators of product bioavailability.

**Poultry**
**Laying hens**

In the trial by Delezie et al. (2014), laying hens were fed diets supplemented with different selenium sources, including L-selenomethionine (Excential Selenium 4000), selenized yeast, or sodium selenite, at inclusion levels of 0.1, 0.3, or 0.5 mg Se/kg feed over an 8-week period to compare selenium transfer to eggs.

- All treatments supported normal performance, but selenium source and dosage markedly influenced selenium status: organic selenium sources resulted in significantly higher selenium concentrations in eggs compared to inorganic sodium selenite (Figure 5).
- Within the organic sources, L-selenomethionine showed substantially higher efficiency of selenium transfer to eggs than selenized yeast, with egg selenium levels reported to be approximately 50% higher for L-selenomethionine at comparable supplementation levels.
- The concept that synthetic L-selenomethionine products deliver approximately twice as much digestible L-selenomethionine compared with selenized yeast.

**L-selenomethionine is the most effective selenium form for enriching eggs with selenium**

These results demonstrate that organic selenium is more bioavailable than inorganic selenium, and that L-selenomethionine is the most effective form for enriching eggs with selenium.

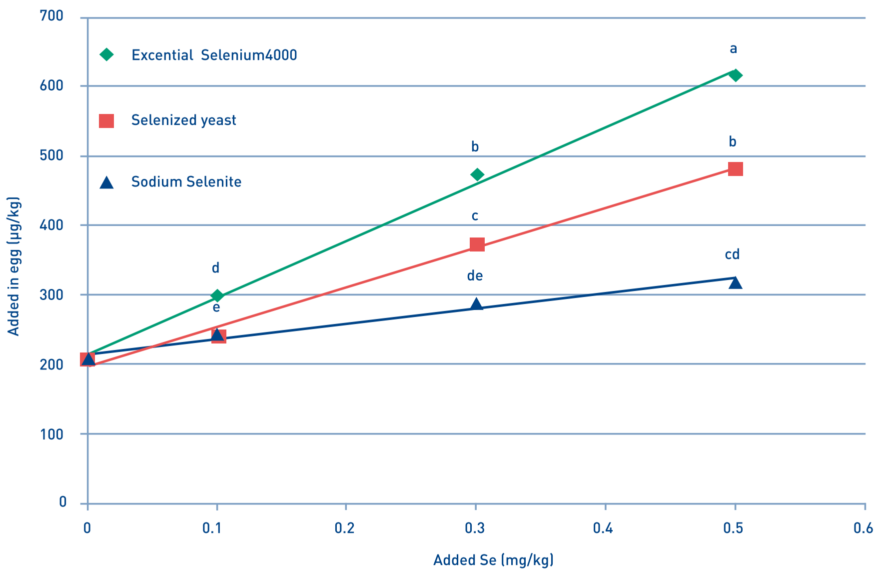



*Figure 5: Selenium deposition in eggs for different selenium sources and levels*

Poultry Broilers

In a study by van Beirendonck et al. (2016), broiler chickens were used to evaluate selenium deposition in breast muscle when diets were supplemented with different selenium sources, with specific attention to the bioavailability of organic forms.

**L-selenometionine is more effective than selenized yeast in increasing selenium deposition in broiler muscle tissue at comparable supplementation levels**

- When comparing L-selenomethionine with selenized yeast, the results clearly showed that L-selenomethionine led to significantly higher selenium concentration in muscle tissue than selenium yeast at comparable supplementation levels (Figure 6).
- This difference was attributed to the difference in L-selenomethionine content between the products.
- The selenized yeast products were analysed to contain 26 and 69% of their selenium as L-selenomethionine, while the L-selenomethionine product (Excential Selenium 4000) contains 100% selenium as L-selenomethionine.

Overall, the trial demonstrated that pure L-selenomethionine is more effective than selenized yeast in increasing selenium deposition in broiler muscle, confirming its superior bioavailability among organic selenium sources.

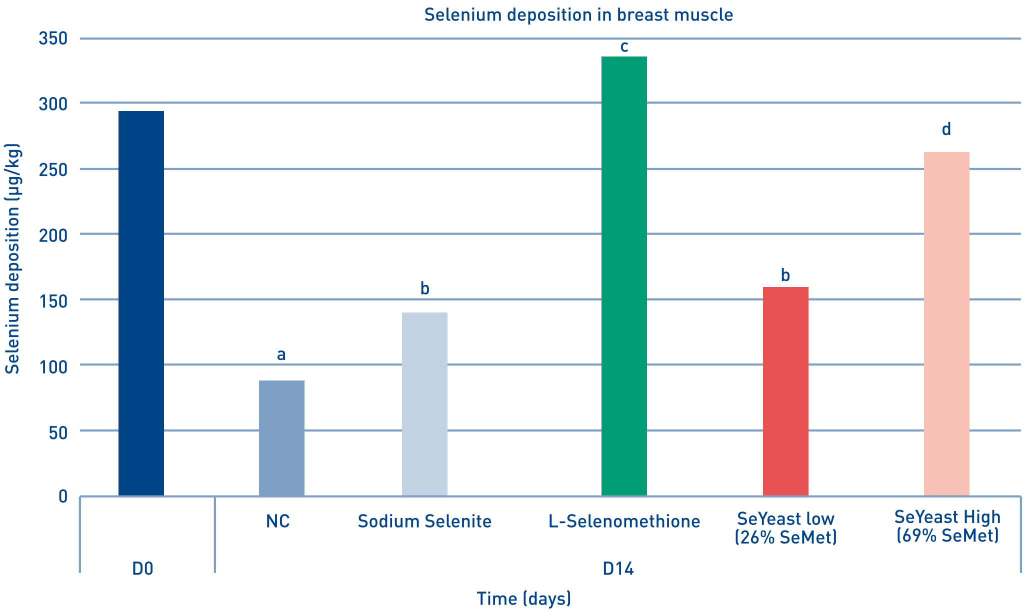



*Figure 6: Selenium deposition in broiler muscle tissue*

Swine
Fattening pigs

In the publication by Falk et al. (2018), different selenium sources were further evaluated in fattening pigs

**L-selenomethionine has approximately 50% better selenium deposition in pig muscle tissue compared to selenized yeast**

- The results clearly demonstrated a higher efficiency of L-selenomethionine compared with selenium yeast for selenium deposition in muscle tissue (Figure 7).
- In this trial, pigs receiving L-selenomethionine showed a significantly higher selenium concentration in muscle tissue than those supplemented with selenium yeast, even when total dietary selenium inclusion was similar.

**Once again, the difference in selenium deposition over the 10 week trial period, was around 50% between selenium yeast and L-selenomethionine, confirming the higher bioavailability of the L-selenomethionine product.**

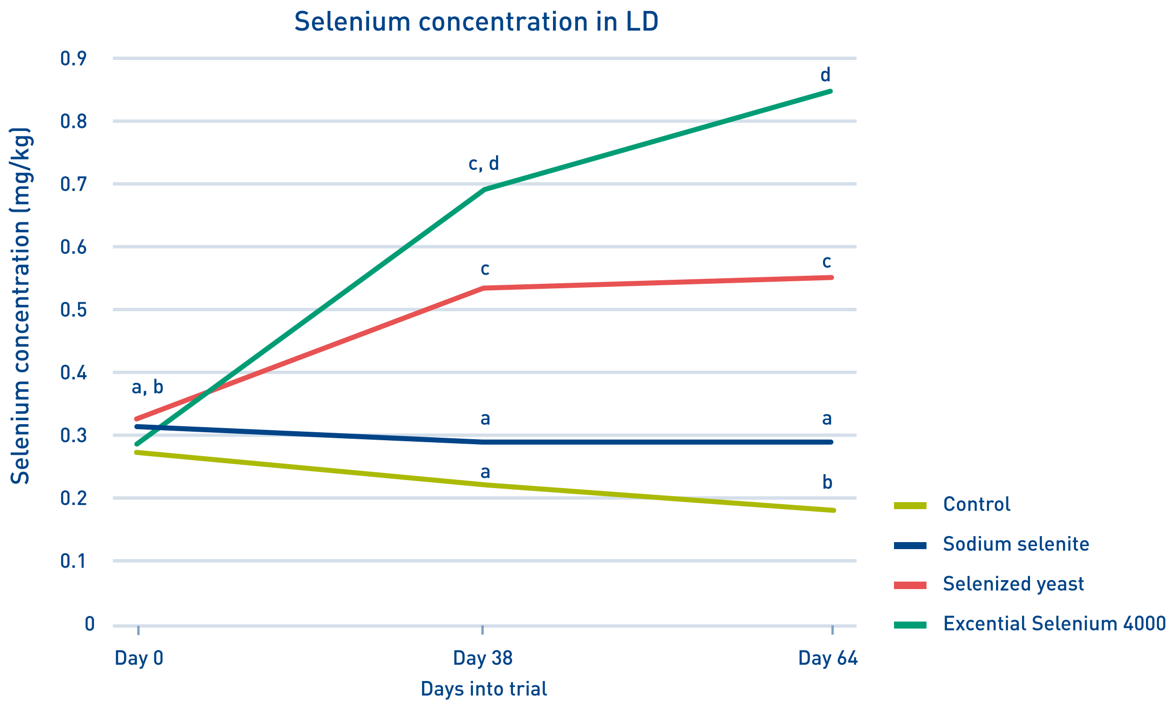



*Figure 7: Selenium deposition in pig muscle tissue*

Ruminants
Dairy cows

In the study by Vandaele et al. (2014), the effects of different selenium sources on selenium deposition in milk of high-producing dairy cows were evaluated by comparing L-selenomethionine, selenized yeast, and sodium selenite at an equal supplementation level of 0.3 mg Se/kg dry matter intake over a 7-week period.

**L-selenomethionine is the most effective selenium source for transferring dietary selenium into milk**

- Clear differences were observed in selenium transfer to milk.
- Both organic selenium sources resulted in significantly higher milk selenium concentrations than inorganic sodium selenite, but L-selenomethionine led to a significantly stronger and faster increase in milk selenium compared with selenium yeast (Figure 8).
- The authors showed that milk selenium levels were primarily driven by the amount of selenium supplied specifically as selenomethionine, rather than total selenium intake, explaining the superior milk selenium enrichment observed with L-selenomethionine.

These results demonstrated that L-selenomethionine is more efficient than selenium yeast in transferring dietary selenium into milk, confirming its higher bioavailability for selenium deposition in dairy cows.

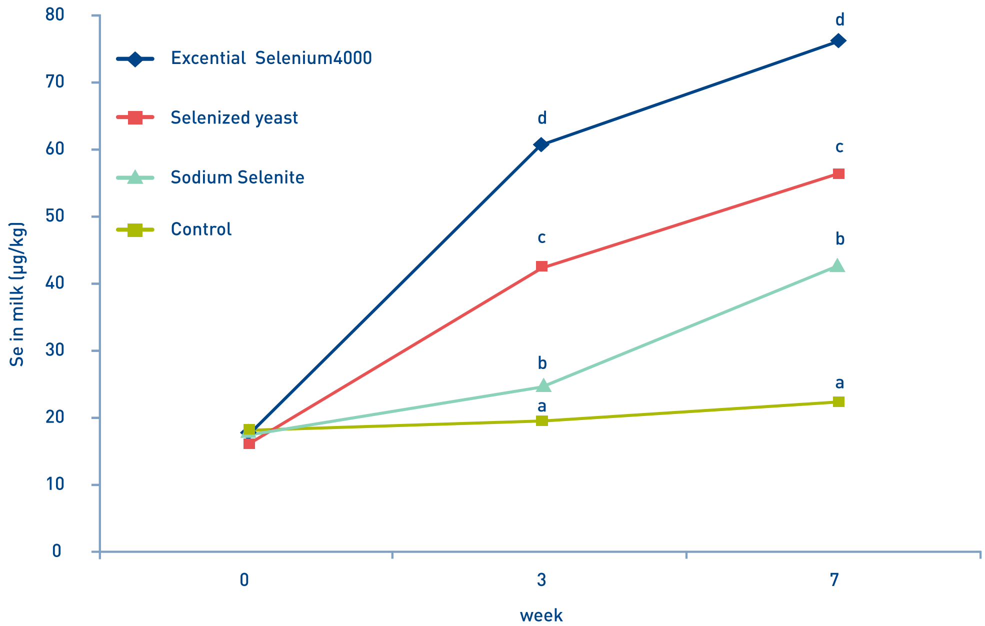
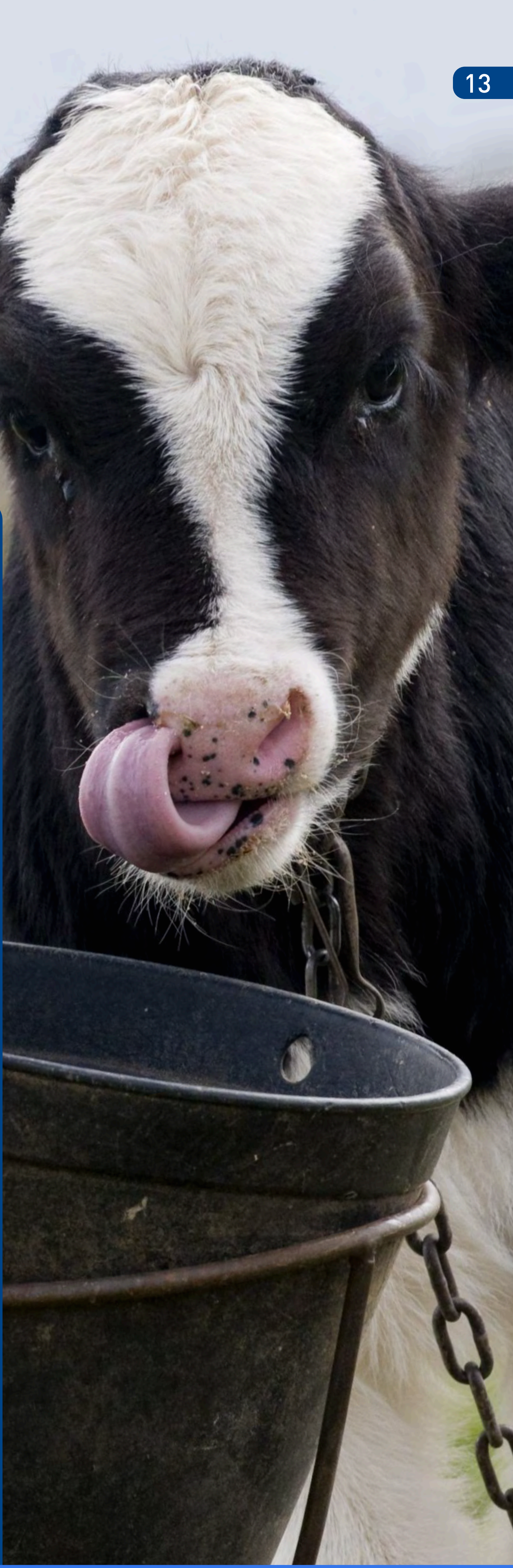



*Figure 8: Selenium deposition in milk for different selenium sources fed to dairy cows*



Overall, the consistent outcomes across poultry, swine and dairy cattle clearly demonstrate that selenium bioavailability is primarily driven by the amount of selenium supplied specifically as L-selenomethionine, rather than by total selenium inclusion alone.

- Deposition trials repeatedly show that pure L-selenomethionine provides higher and more efficient selenium transfer to eggs, muscle and milk compared with selenized yeast, typically resulting in around 50% greater selenium deposition at comparable dietary levels.
- These differences align with the higher and more predictable L-selenomethionine content and digestibility of pure L-selenomethionine sources.

Collectively, the evidence confirms that L-selenomethionine represents the most effective organic selenium form for reliably improving animal selenium status and for delivering consistent, measurable nutritional outcomes across species.

## Stability

Selenized yeast products have been shown to be stable in premix and feed, and the same is true for Excential Selenium 4000. Extensive analytical work and validated quantification methods have demonstrated that Excential Selenium 4000, as a pure product, remains stable under practical and accelerated storage conditions.

**Long-term stability studies (up to 36 months, 25°C and humidity of 60%) and accelerated stability tests (6 months, elevated temperature of 40°C and humidity of 75%) confirmed that selenium and L-selenomethionine levels remain well within specification, even after prolonged storage.**

**These findings were recognized by regulatory authorities, leading to full EU authorization of L-selenomethionine as a feed additive for all animal species in 2014.**

**This approval confirms that stability is not a limiting factor when the additive is correctly incorporated correctly into premixtures.**

Animal trials in broilers showed that Excential Selenium 4000 delivers consistent selenium deposition in muscle tissue, even when the product has been stored under challenging conditions (6 months, 40°C and humidity of 75%). Compared with inorganic selenium sources, Excential Selenium 4000 demonstrated superior muscle deposition and availability with no detectable difference between fresh and stored product (Figure 9).

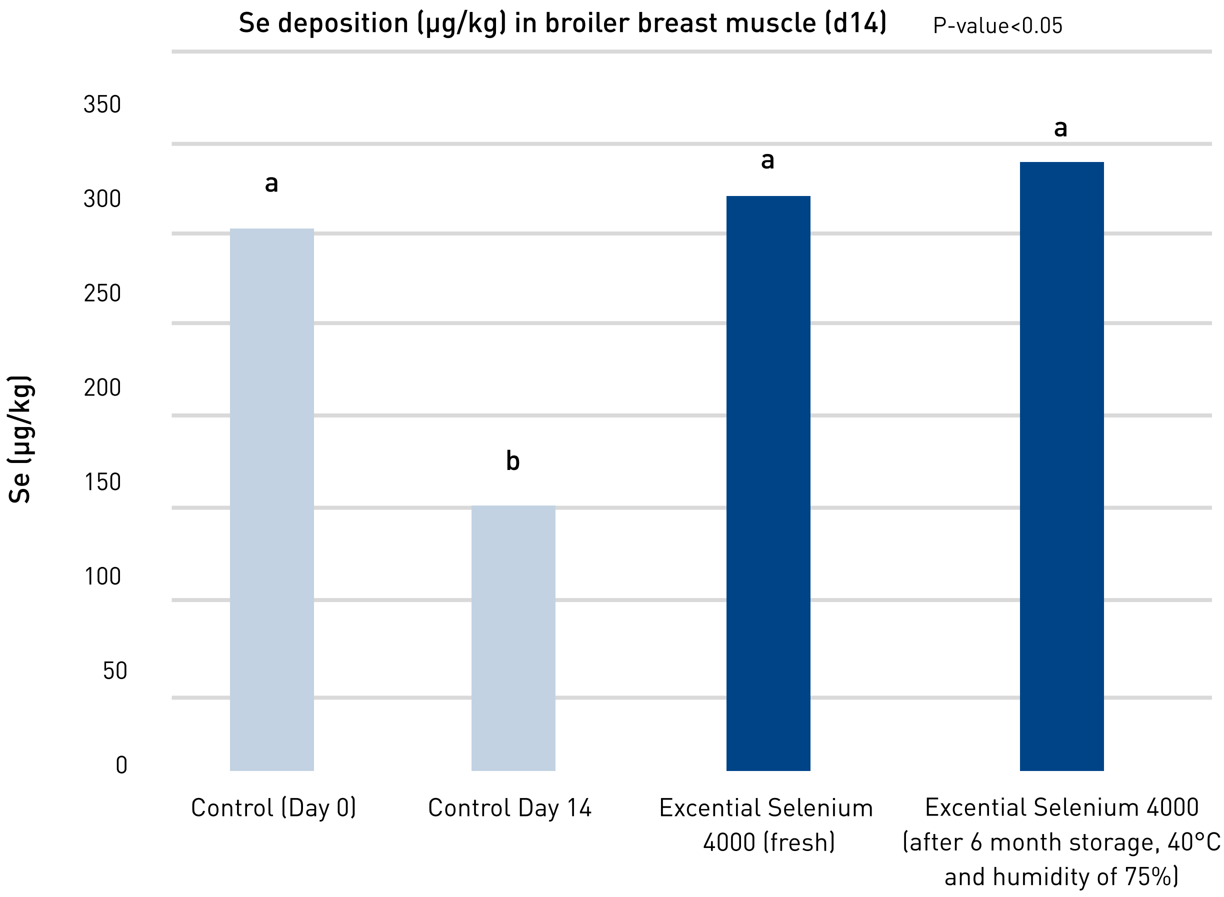



*Figure 9: Selenium deposition in broiler muscle tissue for Excential Selenium 4000 samples*

# Worker's safety

Workers' safety is a critical consideration when handling feed additives, and dustiness can represent a significant occupational risk. Dust consists of solid airborne particles and represents a major concern in industrial workplaces. Exposure to elevated concentrations of dust can lead to occupational diseases that impair lung function, with irritation, asthma, and even cancer associated with dust inhalation. In some cases, dust inhalation has also been associated with an increased risk of cancer, even at relatively low exposure levels. This highlights the importance of reducing the dusting potential of industrially produced compounds, including trace minerals.

To protect workers at premix and feed manufacturing sites, limits have been established to minimize exposure to hazardous substances in the air. These occupational exposure limits (OELs) define the maximum concentration of airborne dust that is considered safe in the workplace. For new feed additive authorizations, the dusting potential of products is explicitly evaluated by the European Food Safety Authority (EFSA) and the European Commission.

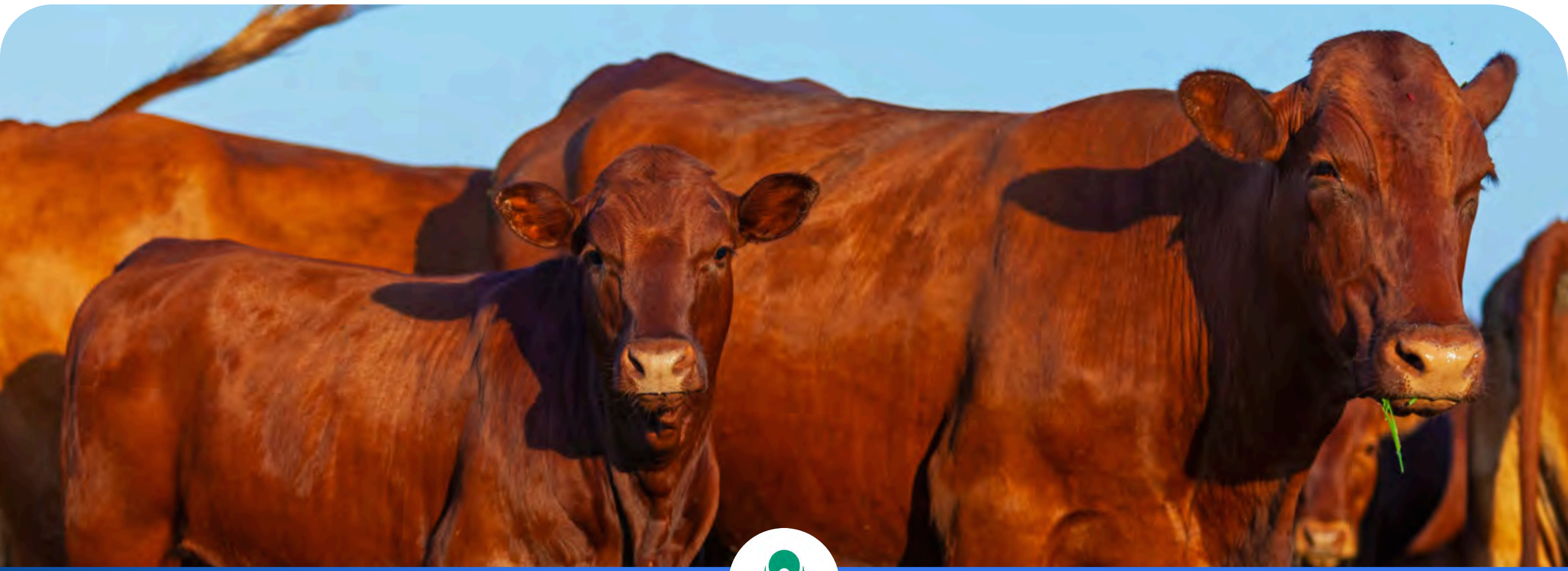
Selenium feed additives are generally considered to be dusty materials, and selenium itself is known to be toxic upon inhalation. Workers who regularly handle selenium-containing products, such as those employed in premix factories, may therefore be at risk of exposure to elevated selenium dust levels, which can adversely affect health. Regulatory authorities therefore place strong emphasis on dusting potential when assessing safety, because inhalation represents the primary route of occupational exposure in premix and feed manufacturing environments.

> Excential Selenium 4000 is the only dust free source of organic selenium under EFSA evaluation criteria

- In its scientific opinions, the European Food Safety Authority (EFSA) has repeatedly identified high dust levels in selenized yeast products (0.55-3.4 mg Se/m³ air), exceeding the Occupational Exposure Limit of 0.2 mg Se/m³ air.
- Other internal analysis provided by an independent lab in the Netherlands, showed even higher selenium in dust levels of 2.0-27.1 mg Se/m³ dust (Table 1). This underlines the risks for safety of the people in the premix/feed factories that work with the product.
- In contrast, Excential Selenium 4000 is effectively dust-free (<0.2 mg Se/m³ air), and therefore does not pose an inhalation hazard for people handling the product.

| Product | Dust Levels (mg Se/m³ air) |
|---|---|
| **Selenized yeast** | 2,0 - 27,1 |
| **Excential Selenium 4000 (L-Selenomethionine)** | <0,2 |

*Table 1: Dustiness of selenized yeast vs L-selenomethionine*



# Excential Selenium 4000 vs selenized yeast: key takeaways

## Selenium functionality depends on form, not just dose

Selenium supports antioxidant defense, immune function, fertility, and thyroid hormone metabolism through its incorporation into selenoproteins. Optimal animal performance therefore depends on both adequate intake and the bioavailable form of selenium supplied.

## L-selenomethionine (L-SeMet) is the most biologically effective selenium form

L-SeMet follows methionine absorption pathways and is the only selenium form that can be non-specifically incorporated into body proteins, creating a safe, mobilisable selenium reserve that supports animals during stress or reduced feed intake.

## Pure L-selenomethionine (Excential Selenium 4000) ENABLES precision and consistency

Excential Selenium 4000 contains 100% of its selenium as L-selenomethionine, produced by chemical synthesis, ensuring batch-to-batch consistency and predictable nutritional outcomes, key requirements for precision mineral nutrition.

## Selenized yeast shows large variability in L-SeMet content

Due to its biological production process, selenized yeast contains variable proportions of L-SeMet, often alongside other selenium forms. Market surveys show substantial supplier- and batch-to-batch variation, with many products failing to meet the EU minimum requirement of of 63% of total selenium present as L-SeMet.

## Digestible L-SeMet is markedly lower in selenized yeast

The availability of L-SeMet from selenized yeast depends on yeast protein digestibility (≈70–80%). As a result, a yeast product containing 63% L-SeMet delivers only about 50% digestible L-SeMet, whereas pure L-SeMet products deliver nearly double the digestible amount.

## Deposition trials consistently demonstrate superior bioavailability of L-SeMet

Across species, pure L-selenomethionine consistently results in higher selenium deposition in eggs, muscle, and milk than selenized yeast at comparable dietary selenium levels.

## Stability of Excential Selenium 4000 is proven

Extensive long-term and accelerated stability studies confirm that Excential Selenium 4000 remains stable in premixtures and feeds. These findings supported full EU authorization of L-selenomethionine as a feed additive for all species.

## Worker safety strongly favors dust free selenium sources

Selenized yeast products show high dusting potential, often exceeding occupational exposure limits for selenium, posing inhalation risks for premix and feed mill workers. Excential Selenium 4000 is effectively dust-free and does not present this hazard.

Pure L-selenomethionine (Excential Selenium 4000) delivers superior bioavailability, consistency, safety, and predictability compared with selenized yeast, making it the most effective and reliable organic selenium source for modern, high-performance animal nutrition systems.

## References

Available upon request
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