AGROLOGY

ISSN 2617-6106 (print)
ISSN 2617-6114 (online)
Agrology, 2024, 7(4), 121–126
doi: 10.32819/202416

Original researches

Received: 15.09.2024
Revised: 30.10.2024
Accepted: 24.11.2024

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Cite this article: Strybul, T., Kovalenko, G., Relina, L., & Shevchenko, N. (2024). Effect of cryofractionated animal placenta extract on winter wheat seed germi-nation. Agrology, 7(4), 121–126. doi: 10.32819/202416

Effect of cryofractionated animal placenta extract on winter wheat seed germination

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Abstract. Adaptation of wheat to stress is the main characteristic of yield stability. Different technologies have been developed to increase yields under stresses. Seed priming has long been practiced worldwide to increase crop stress tolerance. The purpose of this study was to evaluate the effects of pre-sowing treatment of winter wheat seeds with animal placenta extracts Aminoplacentin and Cryoplacentin on initial growth parameters. Three winter bread wheat cultivars were used in the experiments: Verden, Solomiia, and Staleva. Wheat seeds, weighing 30 g, were sprayed with 2 mL of Aminoplacentin, Cryoplacentin, or water, and then shaken for 1 hour to ensure uniform distribution of the solution among the caryopses. The seeds were placed for germination on days 3–4 after treatment. The germination energy and germination rate, mean shoot and root lengths, mean number of roots, dry weight of shoots and roots per germinated seed, mean germination time, T50, and germination index were determined. This study was focused on the effects of pre-sowing treatments – Cryoplacentin, Aminoplacentin, and hydropriming – on three winter wheat cultivars, comparing their impacts on germination rates, early growth parameters, and biomass accumulation. The initial germination energy and rate were high across all the cultivars, with no differences between the treatments and control. However, significant differences appeared in the biometric parameters; for instance, Cryoplacentin increased the root and shoot length in the Verden cultivar. In Solomiia, Aminoplacentin and hydro-priming enhanced the root length. For Staleva, all treatments similarly stimulated the root growth and increased the seedling dry weight compared with the control levels. In the germination dynamics, Cryoplacentin and Aminopla-centin reduced the mean germination time and T50 for Verden and Solomiia, while hydropriming accelerated these metrics without statistical discrepancies among the treatments. Despite the general enhancement, Cryoplacentin prolonged the germination by one to two days for Solomiia and Staleva, suggesting that while the treatments stimu-late early growth, their benefits could be primarily attributed to hydration effects. Treatment of the wheat seeds with the studied solutions improved some parameters of seed germination and biometric parameters of the seedlings. Comparisons of sowing, biometric and time-varying parameters of germination of the analyzed wheat cultivars after pre-sowing treatment of their seeds with water (hydropriming) and solutions of placenta extracts explain the stimu-lating effect of pre-sowing treatment mainly by moistening of caryopses.

Keywords: wheat seeds; hydropriming; placenta extract; germination; biometric parameters.

Introduction

Solving the global food challenge has always been an urgent need for humanity. Agricultural production, particularly grain production, plays a crucial role in addressing this issue. Wheat (*Triticum aestivum* L.) is one of the most important cereal crops, providing nourishment for 4.5 billion people worldwide (Arzani & Ashraf, 2017). Due to its importance, large cultivation areas, and high productivity potential, wheat is often referred to as the "king of cereals" (Mathur et al., 2019). The primary product of wheat is grain, making economic yield the most critical component of its production (Mickky, 2022). Approximately 91% of the world's wheat-growing areas are impacted by environmental stresses, with 50% of yield losses attributed to various abiotic stress factors, including extreme temperatures (27%), salinity (10%), drought (9%), and other stressors (4%) (Kajlaa et al., 2015).

Both bread and pasta wheats exhibit a winter growth habit. Bread wheat cultivars are in greater demand due to their grain mealiness and bread crumbliness, though they are more susceptible to growing conditions and less tolerant to adverse factors than pasta wheat. Therefore, improving the sowing quality of winter wheat seeds is a pressing issue in modern agriculture.

The adaptation of wheat to stress is a key factor in maintaining yield. Various technologies have been developed to boost yields under stress conditions. Seed priming has long been practiced globally to enhance crop stress tolerance. As noted in the review, seed priming can effectively mitigate the effects of various abiotic stresses on wheat plants. Different priming techniques have been employed in this approach. Chemical priming is the most common technique, particularly effective in increasing crop stress tolerance through methods such as hydropriming, halopriming, osmopriming, hormone priming, redox priming, nutrient priming, and nanopriming (Pathak et al., 2019).

Seed hydropriming involves the controlled hydration of seeds to a level that promotes metabolic activity but prevents germination. Hydropriming is a seed treatment technique where seeds are soaked in water for a specific period before sowing, with the soaking duration depending on the species' radicle emergence time. Aeration during soaking may or may not be provided. This method is cost-effective, using only water followed by surface drying or redrying of the seeds to restore their original weight. Research has shown that hydropriming can enhance seed germination, seedling vigor, and overall productivity of crops, even under suboptimal conditions. For example, hydropriming has demonstrated the improvement of wheat germination in saline soils (Roy & Srivastava, 1999). Additional research has confirmed the positive effects of hydropriming on seed germination and seedling emergence across a wide range of crops, including rice, maize, wheat, chickpea, lentil, pearl millet, and others (Sher et al., 2019).

Common agents employed for seed priming include polyethylene glycol, various nutrients, inorganic salts, and biostimulants (Singh et al., 2015, Masondo et al., 2018). Additionally, it has been observed that using plant growth regulators, polyamines, and other organic compounds in seed priming can boost the performance of many crops. Since different priming agents exhibit distinct properties and levels of effectiveness, it is crucial to tailor the priming solution to each specific plant species to achieve optimal results (Horii et al., 2007).

Various natural substances are used as organic fertilizers to improve soil quality and increase yields. To date, some studies have been published on the effects of pre-sowing seed treatments with biologically active organic substances, such as those derived from placental tissue, on the early growth and development of plants. Plant growth regulators, both synthetic and natural, are widely used in Ukraine for pre-sowing seed treatment. One of the commercially available natural preparations produced in Ukraine is Bioglobin. This is a water-salt extract from the placenta of farm animals, after special oxidative-hydrolytic modification processing of the tissues, which contains a complete complex of essential and replaceable amino acids, polypeptides, hexuronic acids, amino sugars, and trace elements. The effects of Bioglobin on the yields of soybean, parsley, parsnip, echinacea, winter wheat, and spring barley have been studied (Shevchenko et al., 2019; Dydiv et al., 2021; Berdin et al., 2022; Dydiv & Dydiv, 2022; Mishchenko & Pospelov, 2023).

Currently, technologies enabling the acquisition of a wide range of biologically active compounds through biosynthesis, as well as cryobiological methods for extracting these compounds from raw biological materials, are considered highly promising. However, replicating natural biochemical processes is both a complex and costly technique. This has led to growing interest, particularly in developed countries, in cryogenic processing technologies for biological materials. These technologies are likely to remain unmatched in the near future for producing high-quality, natural, biologically active substances at the molecular level, which serve as the basis for new products. The use of cryogenic technologies for the extraction of biologically active substances from plant or animal tissues, for example, of fetoplacental origin, is a current and relevant topic of cryobiology (Repin et al., 2023).

The Institute for Problems of Cryobiology and Cryomedicine of the National Academy of Sciences of Ukraine has developed a specialized cryogenic molecular fractionation complex for processing biological materials of both plant and animal origin. This multi-stage system includes advanced cryogenic equipment such as cryotunnels for ultrafast freezing of plant or animal materials using liquid nitrogen vapor, and cryomills that grind materials at temperatures between –60 °C and –120 °C in an inert environment to prevent overcooling and oxidation of biologically active substances. Processed materials are ground to micron sizes using specially designed equipment and then subjected to freeze-drying, molecular fractionation, and low-temperature extraction of fat-soluble vitamins and lipid fractions (Osecky, et al., 2009). At the final stages of processing, protein-peptide complexes are isolated using devices for programmable cryocavitation and cryoconcentration protocols. By using low-temperature molecular fractionation of placenta tissues from farm animals, three drugs can be obtained: Lipoplacentin, Aminoplacentin, and Cryoplacentin (Osetsky & Cnyrnikov, 2020). Given the positive effects of the Bioglobin preparation for pre-sowing seed treatment, the possibility of using placenta-derived peptide preparations, obtained by cryofractionation, for similar purposes arises.

Aminoplacentin is an aqueous fraction that contains amino acids, vitamins, microelements, and carbohydrates. Cryoplacentin is a protein-peptide fraction produced using cavitation technologies from the meal left after cold extraction. It contains amino acids, peptides, nucleic acids, hexuronic acids, polysaccharides, vitamins, and trace elements (Osetsky et al., 2009).

The objective of this study was evaluating the effects of pre-sowing treatment of winter wheat seeds with animal placenta extracts on early growth parameters.

Materials and methods

Object of research. Three winter bread wheat cultivars were used in the experiments: Verden, Solomiia, and Staleva. The seeds were obtained from the collection of the Faculty of Agronomy and Plant Protection of the State Biotechnological University (Kharkiv). All three cultivars are medium-early and equally winter hardy, but have different initial seed vigor. The experiments were carried out in 2023. Dry wheat seeds harvested in 2021 were used; the moisture content after storage in granaries was 11.8 ± 0.5%.

Seed treatment. Aminoplacentin was used as a ready-to-use solution, while Cryoplacentin solution was prepared as follows: 1 g of the dry substance was dissolved in 30 mL of distilled water. After stirring, the mixture was left for 24 hours and then filtered. The wheat seeds weighing 30 g were sprayed with 2 mL of either Aminoplacentin or Cryoplacentin solution and shaken for 1 hour to ensure uniform distribution of the solution across the caryopses. Hydropriming was conducted similarly, but 2 mL of distilled water was used instead of the placental solutions.

Seed germination. Seeds were placed for germination on days 3–4 after treatment. Germination took place in rolls of moistened filter paper kept in a thermostat at 26 °C and 90% humidity. Fifty seeds were used per treatment group (n = 9).

The germination energy (GE) and germination rate (GR) were measured. The germination energy represents the percentage of seeds that germinated by day 4, relative to the total number of seeds, whereas the germination rate refers to the percentage of seeds that germinated by day 8, also relative to the total number of seeds.

Biometrics. We measured the following parameters: mean shoot length, mean root length, and the dry weight of seedlings per germinated seed (all measured on the day of GR determination).

Seedlings from 20 germinated caryopses in each roll were measured, and the mean shoot and root lengths were calculated. The dry weight of seedlings was determined as follows: on the GR determination day, the shoots and roots from 10–13 caryopses were separated, weighed, and dried in a SESh-ZMU drying oven at 105 °C until a constant weight was reached. This weight was then divided by the number of caryopses.

Time-varying parameters. We also measured the germination time of 50% of seeds (T50) (Coolbear et al., 1984), mean germination time (MGT) (Ellis & Roberts, 1981), and germination index (GI) (Walker-Simmons, 1988). The formula interpolates between two time points to estimate the time at which 50% of the seeds have germinated.

The MGT of seeds was calculated as index an average value D – day from day 1 to the day, when the last sprout emerged to n – the number of seeds germinated on day D. The germination index (GI) was calculated as the ratio of the sum of the indices for the number of seeds germinated on days 1 through 6, multiplied by the coefficients 6, 5, 4, 3, 2, and 1, which represent the weight factors assigned to the number of seeds germinated on each corresponding day. This value was then divided by the total number of germination days until the last sprout emerged in this experiment, and further multiplied by the total number of germinated seeds at the time of germination determination.

Statistical analysis. The experiments were performed in six repetitions. The data were statistically processed using Past Statistic v3.01 (University of Oslo, Norway, 2015). The mean values and standard deviations were computed (x ± SD), and the significance of differences between the groups was assessed using Tukey's HSD test, the most common method for multiple comparisons (Nanda et al., 2021). The differences between groups were considered significant at $P < 0.05$.

Results

Dry seeds from each cultivar were used as the corresponding control. The water content in these seeds was typical for seeds stored in granaries. The experimental factors included pre-sowing treatment of seeds with Cryoplacentin or Aminoplacentin, as well as spraying seeds with water (hydropriming). In the experiments with Cryoplacentin and Aminoplacentin, hydropriming was used as a "wet control", while Cryoplacentin and Aminoplacentin treatments were considered experimental variants.

The determination of initial germination rates (control) of the studied wheat cultivars revealed no statistically significant differences in their sowing qualities. The mean GE and GR were 92–95% for the Verden and Solomiia cultivars and 100% for the Staleva cultivar (Tables 1–3).

However, the biometric parameters of the studied cultivars differed significantly. For Solomiia, the mean shoot length was 7.6 cm, and the mean root length was 7.4 cm (Table 2). For Staleva, the mean shoot and root lengths were 9.6 cm and 11.0 cm, respectively (Table 3). For Verden, they measured 8.3 cm and 11.1 cm, respectively (Table 1). A similar pattern was observed for the dry weight of seedlings: 11.4×10^{-3} g in Solomiia (Table 2), 13.5×10^{-3} g in Verden (Table 1) and 15.4×10^{-3} g in Staleva (Table 3).

When the wheat seeds were treated with Cryoplacentin, Aminoplacentin, or water, the following results were observed: the sowing quality (GE and GR) was not affected by pre-sowing treatment with the experimental solutions. The values did not differ significantly from the control or from each other (Tables 1–3). At the same time, certain biometric parameters were stimulated. In the Verden cultivar, hydropriming increased the root length by 20.7% (11.1 cm in the control versus 13.4 cm) and dry seedling weight by 14.8% (13.5 g in the control against 15.5 g). Cryoplacentin caused a 20.7% elongation of the roots (similar to the hydropriming experiment) and a 15.6% increase in the shoot length (8.3 cm in the control versus 9.6 cm). Aminoplacentin increased the shoot length by 18% (8.3 cm in the control against 9.8 cm) (Table 1).

Table 1
Parameters of the germination and seedlings in the wheat cultivar Verden (x ± SD, n = 6)

Treatment	Germination energy, %	Germination rate, %	Length, cm		Dry weight $g\times10^{-3}$
			shoot	root	
Control	94.3 ± 1.8^{a}	95.6 ± 2.2^{a}	8.31 ± 0.63^{a}	11.10 ± 0.92^{a}	13.49 ± 0.98^{a}
Hydropriming	92.4 ± 3.2^{a}	94.8 ± 4.2^{a}	9.03 ± 0.58^{a}	13.43 ± 0.78^{b}	15.54 ± 0.97^{b}
Cryoplacentin	91.2 ± 2.2^{a}	94.3 ± 1.0^{a}	9.65 ± 0.47^{b}	13.45 ± 0.89^{b}	14.87 ± 0.73^{a}
Aminoplacentin	93.7 ± 1.0^{a}	95.0 ± 2.1^{a}	9.84 ± 0.36^{b}	11.41 ± 1.31^{a}	14.22 ± 0.52^{a}

Note: different letters indicate values which reliably differed one from another within one line of the table according to the results of comparison using the Tukey test.

Table 2
Parameters of the germination and seedlings in wheat cultivar Solomiia (x ± SD, n = 6)

Treatment	Germination energy, %	Germination rate, %	Length, cm		Dry weight, $g\times10^{-3}$
			shoot	root	
Control	92.5 ± 3.7^{a}	95.6 ± 2.2^{a}	7.61 ± 0.42^{a}	7.41 ± 0.81^{a}	11.42 ± 0.59^{a}
Hydropriming	94.3 ± 3.7^{a}	94.3 ± 3.7^{a}	8.13 ± 0.71^{a}	8.48 ± 0.79^{a}	13.24 ± 1.08^{b}
Cryoplacentin	86.6 ± 2.9^{a}	89.9 ± 3.9^{a}	8.14 ± 0.53^{a}	9.64 ± 1.08^{b}	12.83 ± 0.81^{a}
Aminoplacentin	91.8 ± 4.3^{a}	93.7 ± 2.8^{a}	8.33 ± 0.80^{a}	10.11 ± 1.07^{b}	13.21 ± 1.07^{b}

Note: see Table 1.

Table 3
Parameters of the germination and seedlings in wheat cultivar Staleva (x ± SD, n = 6)

Treatment	Germination energy, %	Germination rate, %	Length, cm		Dry weight, $g\times10^{-3}$
			shoot	root	
Control	100.0 ± 0.0^{a}	100.0 ± 0.0^{a}	9.62 ± 0.68^{a}	11.01 ± 1.11^{a}	15.37 ± 1.19^{a}
Hydropriming	100.0 ± 0.0^{a}	100.0 ± 0.0^{a}	9.93 ± 0.71^{a}	14.23 ± 1.07^{b}	17.62 ± 0.98^{b}
Cryoplacentin	100.0 ± 0.0^{a}	100.0 ± 0.0^{a}	9.89 ± 0.49^{a}	15.62 ± 1.18^{b}	18.71 ± 0.87^{b}
Aminoplacentin	100.0 ± 0.0^{a}	100.0 ± 0.0^{a}	9.61 ± 0.43^{a}	15.24 ± 1.02^{b}	17.84 ± 0.66^{b}

Note: see Table 1.

The Solomiia cultivar responded to hydropriming with a 15.8% increase in dry seedling weight (11.4 g in the control versus 13.2 g). Cryoplacentin and Aminoplacentin the increased root length by 29.7% and 36.5%, respectively (7.4 cm in the control against 9.6 cm and 10.1 cm) (Table 2).

In the Staleva cultivar, the root length increased by approximately 30–40%, and the seedling dry weight increased by approximately 15–20% after treatment with any of the three solutions, compared with the control values (Table 3). However, when we compared the effects of Cryoplacentin and Aminoplacentin on wheat seeds with the effects of hydropriming, no significant differences in seedling biometrics were observed. The analysis of the dynamics of wheat seed germination after pre-sowing treatment also demonstrated the stimulating effect of these factors on seed germination compared to the control. The T50 was shortened after hydropriming and Aminoplacentin treatment for the Verden and Solomiia cultivars (Fig. 1). The MGT was significantly shortened for the seeds treated with Cryoplacentin or Aminoplacentin in Verden and hydroprimed Solomiia, compared to the control values. It should be noted that a 2-day extension in germination time of the Solomiia and Staleva cultivar seeds was observed compared with hydropriming, following exposure to Cryoplacentin. Also, 1 day extension was observed for the Aminoplacentin-treated Solomiia cultivar (Fig. 2).

The GI was improved after Cryoplacentin and Aminoplacentin treatments in Solomiia only (Fig. 3). Comparison of the wheat seed germination over time after exposure among the two experimental solutions and hydropriming showed that in most experiments the stimulating effects of treatments could be attributed to wetting, except for the germination time of the Solomiia and Staleva cultivars; a slowdown of these indices was observed in this study.

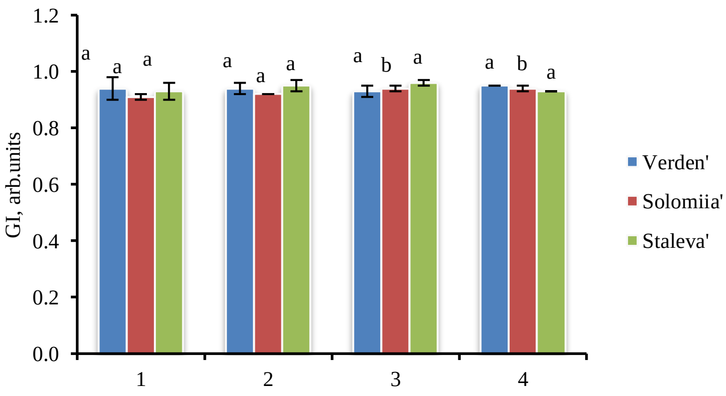

Fig. 1. Half-germination time (T50) of winter wheat Verden, Solomiia, and Staleva cultivars after exposure: *1* – control, *2* – hydropriming, *3* – Cryoplacentin, *4* – Aminoplacentin (x ± SD, n = 6); different letters indicate values which reliably differ one from another within one line of the table according to the results of comparison using the Tukey test

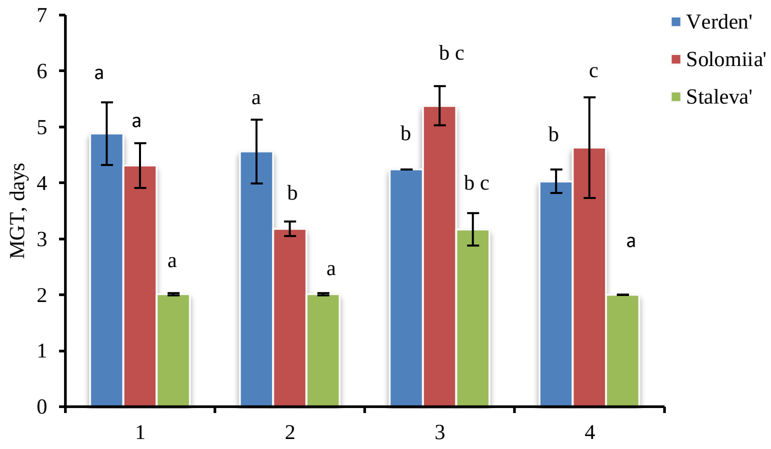

Fig. 2. Mean germination time (MGT) of winter wheat Verden, Solomiia, and Staleva cultivars after exposure: *1* – control, *2* – hydropriming, *3* – Cryoplacentin, 4 – *A*minoplacentin (x ± SD, n = 6); see Figure 1

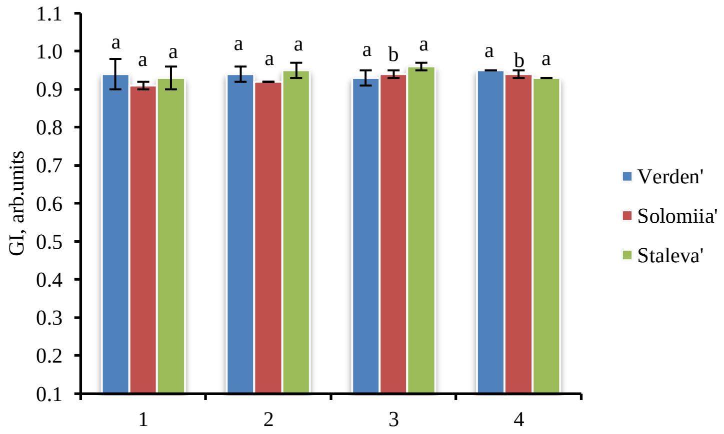

Fig. 3. Germination index (GI) of winter wheat seeds Verden, Solomiia, and Staleva cultivars after exposure: *1* – control, *2* – hydropriming, *3* – Cryoplacentin, *4* – Aminoplacentin (x ± SD, n = 6); see Figure 1

Discussion

The stimulating effect of hydropriming can be explained by the activation of various biological processes during seed wetting. Hydropriming activates hydrolytic enzymes, particularly alpha-amylase, as well as antioxidant enzymes such as superoxide dismutase, catalase, and peroxidase. It also enhances the expression of proteins involved in responses to water and heat stresses, and intensifies carbohydrate mobilization in the seed endosperm. During germination, such seeds exhibit enhanced scavenging of reactive oxygen species. These activation processes disrupt seed dormancy, leading to accelerated germination and increased germinability (Farooq et al., 2019). We observed similar effects in our experiments.

One could expect biologically active substances, in particular amino acids, in the tested animal placenta solutions to function as regulators for plant germination and growth. For example, proline is known as a priming agent improving germination and growth parameters, both under normal and stressful conditions. Proline priming improved the growth of bread wheat (*Triticum aestivum* L.) cultivars under normal conditions (Ambreen et al., 2021). Exogenous proline application ameliorated toxic effects of arsenate in eggplant (*Solanum melongena* L.) seedlings (Singh et al., 2015). Proline treatment of lettuce (*Lactuca sativa* L.) seeds may be beneficial for maintaining a normal photosynthetic capacity and mineral uptake in seedlings under cadmium stress (Selović et al., 2023). Proline was found to be a successful priming agent to alleviate salinity-induced adverse effects on the early developmental stages of Cakile maritime plants (Messedi et al., 2024). Shams et al. (2024) revealed that Maras, a free proline-rich *Capsicum annuum* L. genotype, was more salinity-tolerant in terms of germination and plant growth than the other genotypes, which contained less proline. Proline priming maintained the physiological activity during germination of rice (*Oryza sativa* L.) under salt stress (Singh et al., 2018). This amino acid can function as an osmoprotector: free proline contributes to maintaining the osmotic pressure balance between protoplasts and the environment (Wang et al., 2024). Proline is also an antioxidant (ROS scavenger) (Ghosh et al., 2022). It stabilizes protein structures by promoting protein hydration at low temperatures and thus protecting spatial conformations of enzymes. Proline ensures membrane integrity through hydrogen bond interactions (Trovato et al., 2019). Other amino acids may also modulate plant germination and growth. Tryptophan, as a signal molecule, mediates many physiological responses in plants. Treatment of sunflower (*Helianthus annuus* L.) seeds with tryptophan minimized lipid peroxidation and improved the root and shoot lengths, root and shoot fresh weights, germinability of seeds, average leaf area, and other parameters under cadmium stress (Hussain et al., 2024). Arginine is one of the most functionally diverse amino acids and a precursor for biosynthesis of polyamines and nitric oxide, which were shown to be involved in different biological processes, including growth, development, and responses to abiotic stress. Arginine priming increased the seed germination rate in *T. aestivum* seeds at low temperature (Li et al., 2024). Arginine treatment of pepper (*Capsicum annuum* L.) seeds increased the rates of sprouting and promoted the root development in early stages of vegetation (Barcanu et al., 2020). Aspartic acid, glutamine, lysine, methionine, phenylalanine, and tyrosine can also stimulate germination (Sowmya, et al., 2023). Aspartic acid treatment restored the seed germination rate and root vigor of seedlings, as compared with the control (non-damage) level, in a salt-tolerant Tartary buckwheat (*Fagopyrum tataricum*) cultivar under salt stress, and also improved these parameters greatly in a salt-susceptible cultivar (Zhang et al., 2019). Lysine and tyrosine priming improved the root fresh weight, shoot length, leaf dry weight, germination percentage, root and shoot vigor, number of pods, and other parameters in cadmium-stressed mung bean (*Vigna radiata* L.) (Mahmood et al., 2022). Abdelkader et al. (2023) treated onion (*Allium cepa* L.) seeds with exogenous amino acids and found that methionine, proline, and tryptophan were the best priming agents to increase germination percentage, while glutamine enhanced the vigor index. In addition, they reported that the most extended root system was obtained after glutamine, glycine, proline, and tryptophan treatments and the maximum shoot length was produced by glutamine and tryptophan treatments. Exogenous phenylalanine increased the salinity tolerance (germination percentage, leaf area, fresh and dried root and shoot weights, and root and shoot lengths) in corn (*Zea mays* L.) at the seedling stage (Zahra & Mahmood, 2018; Zahra et al., 2020).

Unfortunately, the biologically active substances in the tested animal placenta solutions did not significantly affect wheat seed germination, compared with hydropriming, except for the indices of MGT. It is possible that we did not achieve optimal treatment conditions. As with the quantitative composition of the tested extracts, the concentrations of at least some amino acids were generally in the ranges used by other researchers or far exceeded them. Mahmood et al. (2022) used 0.2% (13.7 mmol/L) lysine to treat mungbean seeds. Abdelkader et al. (2023) treated onion seeds with exogenous lysine at a concentration of 0.5 g/L (3.43 mmol/L). The lysine concentration in Aminoplacentin is 40 mmol/L (Osetsky et al., 2009). Abdelkader et al. (2023) also used 0.5 g/L of alanine (5.61 mmol/L), 0.5 g/L of serine (4.46 mmol/L), and 0.5 g/L of threonine (4.20 mmol/L) for priming of onion seeds. The concentrations of alanine, serine, and threonine in Aminoplacentin are 10.2, 10.2, and 7.0 mmol/L, respectively (Osetsky et al., 2009).

Also, we should not rule out the possibility that the physiological changes in seeds induced by biologically active organic substances may manifest at later stages of plant development, rather than during the initial growth phase.

We believe that further research into the effects of biologically active substances derived from animal tissues on plants is crucial, as the number of studies highlighting their role in plant growth and development is currently increasing.

Conclusion

Seed priming offers a smart, innovative, realistic, and effective option for achieving faster and uniform germination, vigorous stand establishment, and higher productivity in crop plants under normal and stressful conditions. Treatment of wheat seeds with the studied solutions improved certain germination parameters and biometric characteristics of the seedlings. Hydropriming and treatment with Cryoplacentin or Aminoplacentin improved the biometric parameters such as root length and dry seedling weight in most cases, compared to non-treated seeds of the studied wheat cultivars. Improvement in some time-varying germination parameters was observed in the Verden and Solomiia cultivars following hydropriming and Aminoplacentin treatment, compared with dry seeds. The exposures of winter wheat varieties Solomiia and Staleva to Aminoplacentin and Cryoplacentin resulted in delayed germination time compared with hydropriming. The comparisons of sowing, biometric, and time-varying germination indicators for the studied wheat cultivars after pre-sowing treatment with water (hydropriming) and placenta extract solutions suggest that the stimulating effect of pre-sowing treatment is primarily due to the moistening of the caryopses. Field research is planned to investigate the potential of using placental preparations obtained through cryofractionation as a bio-stimulant to enhance winter wheat yield. The study will explore how the bioactive components present in placental tissues, such as peptides and growth factors, could positively influence the wheat growth, seed germination, and resistance to environmental stresses. By integrating these natural bioproducts into agricultural practices, the research aims to develop sustainable methods for boosting crop productivity while reducing dependence on chemical fertilizers and synthetic growth promoters.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The authors declare that the study was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

The authors would like to express their gratitude to Oleksandr Osetsky, a leading researcher of the Cryoprotectant Laboratory, for providing Aminoplacentin and Cryoplacentin.

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