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Medicinally İmportant Representatives Of The Brassicaceae Burnett. Family Cultivated İn Agriculture And Their Effect On The Neonatal Development Process

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ABSTRACT
The article discusses the medicinally significant representatives of the Brassicaceae Burnett family cultivated in agricultural practices. These include *Armoracia rusticana* (Gaertn.) C.A. Mey. & Scherb. from the genus *Armoracia* (Gaertn.) C.A. Mey. & Scherb., *Brassica oleracea* L. from the genus *Brassica* L., *Lepidium sativum* L. from the genus *Lepidium* L., and *Raphanus sativus* L. from the genus *Raphanus* L. The article provides information about the biochemical composition of these plants relevant to the neonatal developmental period. During the neonatal period, the brain develops intensively, and the immune system is weak. The paper outlines the vitamins, minerals, and other substances in these plants that are essential for normal brain development and immune strengthening. Additionally, the article highlights the importance of these plants in other fields and their roles in the treatment of various diseases.

Keywords: *Brassicaceae Burnett., neonatal development, family, genus, plant*

1. INTRODUCTION

The neonatal period (birth to 1 month) is a time of extensive and ongoing system transition from uterine environment to external world, this includes the initial period after birth which is referred to as the perinatal period [35].

The neonatal period is the time when the infant's immune system is weak. During this time, the infant's nervous system develops rapidly. The brain needs optimal nutrition to achieve its goals as it is a metabolically very active organ that consumes a significant proportion of nutrient and energy intake. Therefore, nutrition in the last phase of fetal development and the neonatal age can critically impact the cognitive abilities and mental development of the future adult [Goyal, M.S., et al., 2018, Julián Rodríguez-Suárez et al., 2023].

Materıals and methods of the study. As research objects, the following medicinally significant cultivated plants from the Brassicaceae Burnett family were selected: Brassica oleracea L., Armoracia rusticana (Gaertn.) C.A. Mey. & Scherb., Raphanus sativus L., and Lepidium sativum L. Biochemical analyses were conducted to determine the content of nutritionally and medically important compounds in these plants. The amount of vitamin C (ascorbic acid) in the samples was determined using acid-base titration with 0.1 M NaOH solution. The fat content was measured using the Soxhlet extraction method. Protein content was determined using the Lowry photocolorimetric method and the Kjeldahl method. For the determination of other compounds (e.g., glycosides), more precise methods such as biological spectrophotometry and high-performance liquid chromatography (HPLC) were used.

Discussion of the research. Infant supplementation with vitamin K, vitamin D, and vitamin B-12 early in lactation and with iron after 6 mo of age may be indicated to buffer for insufficient reserves and inadequate transfer via breast milk. For many nutrients, the effect of maternal factors on breast milk concentrations has been investigated, but for several of the B-vitamins, including thiamin, riboflavin, and vitamin B-6, additional data are needed [Daphna K. Dror, 2018]. Breast milk is an irreplaceable source of nutrition for the infant, especially during the neonatal period. The composition of this food depends on the nutrients present in the mother's diet. Therefore, breast milk must contain essential substances for the normal development of the nervous system and for strengthening the immune system. Cultivated representatives of the Brassicaceae Burnett. family are considered appropriate as they are rich in these substances.

Since ancient times, medicinal plants have attracted human interest. As in every plant family, the Brassicaceae Burnett. family also has medicinally valuable representatives. Alongside its wild species, the Brassicaceae Burnett. family includes

representatives that are cultivated in agricultural systems. Several medicinally important species from the genera Armoracia (Gaertn.) C.A. Mey. & Scherb. (Armoracia rusticana (Gaertn.) C.A. Mey. & Scherb.), Brassica L. (Brassica oleracea L.), Lepidium L. (Lepidium sativum L.), and Raphanus L. (Raphanus sativus L.) are cultivated for agricultural purposes.

Archaeologists report that cabbage was used during the Stone and Bronze Ages. The ancient Egyptians, Greeks, and Romans cultivated this vegetable. The ancient Greek philosopher and mathematician Pythagoras was involved in the selection of cabbage and highly valued its medicinal properties [36].

***Brassica oleracea* L.** contains on average 90.0% water, 1.8% protein, 4.6% sugars, 0.5% starch, 0.7% cellulose, 0.05% organic acids, and 0.7% mineral substances [Ahmadov, A.I., 2014]. Chemical components analysis has shown that the main constituents of cabbage are carbohydrates, comprising nearly 90% of the dry weight, where approximately one third is dietary fiber and two thirds are low-molecularweight carbohydrates (LMWC). Other characteristic components are glucosinolates [Wennberg, M. et al., 2006, Sami Rokayya, et al., 2013]. Some studies have been conducted to quantify the phenolic compounds, carotenoids, vitamin C, and antioxidant potential [Nilsson J. et al., 2006, Kusznierewicz et al., 2008]. The antioxidant properties were tested in many studies by using different approaches [Liu, D. et al., 2008, Zanfini, A. et al., 2010]. The content of antioxidants depends on a lot of factors, especially on cultivars, stage of maturity and growing conditions [Hart, D.J., Scott, K.J.1995]. Among the vitamins, *Brassica oleracea* L. contains vitamin C (15–70 mg%), B_1 (0.05–0.1 mg%), B_2 (0.05–0.02 mg%), β-carotene (0.02–0.3 mg%), PP (0.4–0.9 mg%), as well as vitamins K, P, and B_3. The biochemical composition of the plant is not stable; soil and climatic conditions cause variations in its content. Half of the nitrogen-containing substances in its composition are proteins. The unpleasant odor produced during the cooking of *Brassica oleracea* L. is associated with sulfur in its protein content, which leads to the release of hydrogen sulfide and mercaptan. It also contains biologically active compounds such as choline (a nutrient similar to B-complex vitamins) and betaine. Although the body synthesizes a certain amount of choline, additional intake is also necessary. Betaine, which has antioxidant properties, protects cells from free radical damage, supports detoxification processes, exhibits anti-inflammatory effects, and is beneficial for liver and cardiovascular health. The main sugar present in the plant is invert sugar. Additionally, it contains hemicellulose, which has a prebiotic effect (feeding beneficial bacteria in the intestinal microflora), as well as small amounts of sucrose, galactose, and maltose. Among the lipid compounds, there are lipids (0.01–1.7%) and mustard oil (7 mg%), which have antibacterial and antifungal effects. Mustard oil protects the skin of infants and strengthens the muscles. It is used for massage (even during the neonatal period) and as a protective oil before sun exposure in some regions. Among organic acids, it contains citric and malic acids, and among mineral substances, it has calcium (43.2 mg%), which is the basis of bone tissue, phosphorus (22 mg%) found in nerve tissue, potassium (210 mg%) which regulates the water content in tissues and improves heart function, sodium (23 mg%) which maintains osmotic pressure in tissues, iron (0.4–1.1 mg%) found in hemoglobin, and others. The color of the plant's leaves affects the numerical indicators of its composition. For instance, in white-leaved forms, sugars and nitrogenous substances are richer compared to the blue-leaved forms. Vitamin C is more abundant in the inner leaves than in the upper leaves. The phytoncides, vitamins, enzymes, potassium, phosphorus, and sulfur salts in the plant play an important role in the organism.

***Brassica oleracea* L.**

***Armoracia ructicana* (Gaertn.) C.A. Mey. & Scherb.** (horseradish), a member of the Brassicaceae family, has been known since ancient times as a folk medicinal herb and as a plant of nutritional value and culinary interest [Rosa Martha Pérez Gutiérrez and Rosalinda Lule Perez, 2013]. Horseradish, Armoracia rusticana G. Gaertn., B. Mey. et Scherb., is an extremely hardy perennial plant, member of the Brassicaeae family [Weber, W.W. 1949, Shehata, A.M. et al. 2009]. Its root and leaves have been used in antiquity as both a medicinal herb and a condiment [Rosengarten F. Jr. 1969], and the latter use is the principal nowadays. It is currently cultivated for its thick, fleshy and white roots that have a mix of delicious intense pungency and cooling taste which is caused by sulfur compounds, namely glucosinolates (GLSs) [Balasinska, B. et al. 2005, Walters, S.A. and Wahle, E.A. 2010, Weber, W.W. 1949]. The plant, which is mainly used for its roots, has an odor reminiscent of the fragrance of the bugbane plant. The plant's strong taste and odor are due to the presence of sinigrin glucoside, which has antibacterial, antiviral, anti-inflammatory effects, supports detoxification, and is beneficial for the digestive system. The root contains 73.85% water, 3.35% protein, 23–32% dry matter, 13.3% nitrogen-free extractive substances, 2.58% cellulose, 4.5% protein, and 9.6% sugar [Ahmadov, A.I., 2014]. Sodium (7.9 mg%), potassium (579 mg%), calcium (119 mg%), manganese (35.3 mg%), copper (0.14 mg%), phosphorus (70 mg%), sulfur (212 mg%), chlorine (18.8 mg%), as well as 200 mg% of vitamin C in both the leaf and root tuber, sufficient amounts of B vitamins, glucosides, carotene, and lysozyme (a bactericidal protein substance) are present. The plant stimulates appetite, improves intestinal function, and is very beneficial in the treatment of gastritis. It is also used in cosmetics (against freckles and pigmented spots). Its juice and aqueous solution increase the secretion of hydrochloric acid in the stomach. As an antibacterial and diuretic, it is effective in treating cross-shaped lumbago, back and lumbar muscle pain, purulent wounds, and ear inflammation. A mustard-like "plaster" is made from the plant, which is used for colds, muscle, and joint pain.

Armoracia rusticana (Gaertn.) C.A. Mey. & Scherb.

***Raphanus sativus* L.** One of the promising plant ingredients is *Raphanus sativus* L. (garden radish) – a biennial plant of the Cruciferae family, which has been used in traditional medicine since ancient times as a preventive and medicinal remedy for various diseases [Bityueva, E.B., Biltrikova, T.V. 2015]. It is known that *Raphanus sativus* L. has antitumor, antioxidant, and antimicrobial effects on the human body, due to the presence of biologically active substances in it [Rusakova, G.G., Merlin, E.A., et al. 2008].

Alkaloid and nitrogen compounds present in t he roots were pyrrolidine, phenethy lamine, N-methylphenethylamine, 1,2′ -pyrrolidin-tion-3-il-3-acid-carboxilic-1,2,3,4-tetrahydro-β-carboline, andsinapine [Marquardt, P. 1976, Wan, C., 1984, Weilan, W. Et al, 1987]. Cytokinin (6-benz ylamino-9-glucosylpurine) is a major metab olite of 6-benzylaminopurine (6-BAP) in the root radish. A minor metabolite of 6-BAP from radish has beenidentified as 6-benz ylamino-3-β-D-glucopyranosylpurine [Coeley, D.E. et al, 1975]. Total am ino acids were 0.5% of dry wt; with proline (0.5%) as the major

constituent, methionine and cystine were present in traces (0.02%). Diamines as diaminotoluene (2,4-D), 4,4´ - methylenedianiline (4,4-D), and 1,6-hexanediam ine (1,6-D) were isolated in the period of germ ination of young radish seeds. Production of thiamine is higher duringgermination radishes [Mal-Nam, K., 2002, Rosa Martha Pérez Gutiérrez and Rosalinda Lule Perez, 2004].

Due to the essential oil content, it has a strong taste that is both pungent and sweet. It is mainly used in the preparation of salads. It contains up to 7% carbohydrates, including up to 6.2% sugar, up to 2% protein, 1.2% nitrogenous substances, phosphorus, iron, and sulfur salts, as well as vitamins – 29 mg% of vitamin C, B_1, B_2, and PP. According to the ancient Greek scholar Dioscorides, the plant aids in the digestion of food. Galen, on the other hand, recommended it for stimulating appetite [Ahmadov, A.I., 2014]. The cellulose content positively affects the motor function of the intestines and leads to the excretion of excess cholesterol from the body, playing an important role in the prevention of atherosclerosis. In traditional medicine, it is effective in treating conditions such as bronchitis, upper respiratory tract inflammation, pulmonary tuberculosis, dissolving bladder stones, treating gallstones, acting as a diuretic and cholagogue, as well as in the treatment of gout, rheumatism, myositis, neuritis, radiculitis, purulent wounds, and eczema. Due to its antibacterial lysozyme content, it is beneficial in wound healing.

***Raphanus sativus* L.**

***Lepidium sativum* L**. is known for its various activities since ancient time and recently seeds in particular are being popularly promoted as functional food too. The seeds are rich in minerals, vitamins, essential fatty acids. protein, amino acids and flavonoids, alkaloids, saponins. Iron (Fe), copper (Cu), zinc (Zn), manganese (Mn), boron (B), molybdenum (Mb), aluminum (Al), potassium (K), phosphorus (P), calcium (Ca), sodium (Na), magnesium (Mg), sulfur (S) constitute the mineral composition of the plant (mainly in its leaves), along with vitamins A, C, D, B_6, and B_{12}.In various animal experimental studies the crude extract of L. sativum is shown to exert antispasmodic effect through a combination of multiple pathways including activation of K+ channels, and inhibition of muscarinic receptors, Ca++ channels and PDE enzyme [Rehman N.U. et al, 2012, Gilani A.H. et al, 2013, Doke S. GM. 2014, Mamta B. et al, 2021].

Due to the presence of glucotropaeolin and lepidin glucosides, the plant has a bitter, pungent taste. It contains 2.27 mg% carotene. These substances vary depending on the characteristics of the soil in which it is grown. The essential oil obtained

from the plant is primarily composed of benzyl-mustard oil. It is also used in culinary applications, added to various salads, sauces, meat and fish dishes, and soups. It is considered beneficial as an appetite stimulant, for the treatment of scrofula (young leaves), avitaminosis, anemia, jaundice, scabby wounds, and purulent ulcers. The powdered product obtained from the plant's seeds can be used as a mustard-like irritant.

***Lepidium sativum* L.**

The medicinally important representatives of the *Brassicaceae* family cultivated in agricultural practices have been studied by researchers worldwide. These representatives are also found in the Belgorod region. They are adventive and belong to the following geographical area types: *Armoracia rusticana* (Gaertn.) C.A. Mey. & Scherb. – North America, Scandinavia, Atlantic Europe, Central Europe, Eastern Europe, the Caucasus, Western Siberia, Central Asia, Eastern Siberia, the Far East, the Mediterranean, Asia Minor, Iran, Junggar-Kashgan, Mongolia, Indo-Himalayas, Japan-China. *Brassica oleracea* L. – North America, Scandinavia, Atlantic Europe, Central Europe, Eastern Europe, the Caucasus, Western Siberia, Central Asia, Eastern Siberia, the Far East, the Mediterranean, Asia Minor, Iran, Junggar-Kashgan, Mongolia, Indo-Himalayas, Japan-China. *Raphanus sativus* L. – North America, Scandinavia, Atlantic Europe, Central Europe, Eastern Europe, the Caucasus, Western Siberia, Central Asia, Eastern Siberia, the Far East, the Mediterranean, Asia Minor, Iran, Junggar-Kashgan, Mongolia, Indo-Himalayas, Japan-China, Australia, Africa.

Lepidium sativum L. – Central Europe, Eastern Europe, the Caucasus, the Mediterranean, Asia Minor, Iran, Africa, the Himalayas. The analysis of the above summary shows that the cruciferous plants belong to 6 typical phytocenoses of the Belgorod region: forest, meadow, steppe, swamp and wetland species, chalk outcrops, and synanthropic [Kolchanov A.F. et al, 2012].

2. CONCLUSİON

Thus, based on the conducted research, it has been determined that the biochemical substances necessary for brain and immune development during the neonatal period are components of the medicinally important representatives of the Brassicaceae Burnett family cultivated in agricultural practices. These plants contain vitamin C, which strengthens the immune system; vitamin B_1, which is beneficial for the nervous system and brain function; the antioxidant β-carotene; vitamin PP, which supports sleep and the nervous system; and vitamins K, P, and B_3, which support bone health. Additionally, choline, which positively affects brain development and function, and lipids, which are essential for the brain and nervous system (as the myelin sheath is lipid-based), are also present. Furthermore, sodium is one of the mineral components involved in regulating water balance, transmitting nerve impulses, muscle function, blood pressure regulation, and the transport of nutrients (such as glucose and amino acids) into cells. Since the nervous system develops intensively during the neonatal period, sodium (ions) is considered highly important for the transmission of signals between nerve cells.

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