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Article

Biochemical Composition Analysis of Hot Pepper Varietal Samples in Greenhouse Conditions

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Abstract: This study investigates the biochemical composition of 35 varietal samples of hot pepper (Capsicum annuum L.) cultivated in greenhouse conditions to address the knowledge gap in understanding the nutrient profile and spiciness of these cultivars. Utilizing a combination of greenhouse and laboratory experiments, the research adheres to established methodologies for vegetable crop studies and employs statistical analysis via Microsoft Excel. Findings reveal significant variations in dry substance, ascorbic acid, mono- and disaccharides, and nitrate content among the samples. Key results indicate that specific cultivars exhibit higher nutrient levels and spiciness compared to the control variety, Margilon 330. The implications of this research suggest the potential for breeding hot pepper varieties with enhanced nutritional quality and suitability for greenhouse cultivation, contributing to improved agricultural practices and consumer health benefits.

Keywords: Greenhouse, Hot Pepper, Cultivar, Dry Substance, Ascorbic Acid, (Vitamin C), Mono And Disaccharide, Spiciness Level, Biochemical Composition, Laboratory

1. Introduction

Hot pepper (*Capsicum annuum* L.) (chili pepper) is planted on 4.4 million hectares worldwide, and 68.3 million tons of products are grown from it. The average yield is 100-110 tons per hectare in greenhouses, and 14.1-18.3 tons in open fields. Nowadays, interest and demand for hot pepper crop is increasing day by day, this crop is grown in all countries of the world. Although the global average yield of hot pepper (*Capsicum annuum* L.) "in open fields increased from 7.3 tons in 2006 to 18.4 tons in 2019, and increased from 80 tons to 110 tons in greenhouses", the creation of new cultivars of hot pepper resistant to diseases and pests, heat and cold, suitable for cultivation in salty soils, is one of the urgent issues of today.

2. Materials and Methods

The methodology of this study involved a comprehensive approach to evaluating the biochemical composition of 35 varietal samples of hot pepper (Capsicum annuum L.) cultivated under greenhouse

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conditions. The research was conducted in accordance with standardized protocols, including the "Methodology of experimental work in vegetable and melon growing" and the "Guidelines for conducting experiments with vegetable crops in protected ground structures (SRIVF)." The experimental work began with the planting of hot pepper varieties in a controlled greenhouse environment, ensuring uniform growth conditions for all samples. Throughout the growing period, regular monitoring and maintenance were conducted to ensure optimal growth and development of the plants.

Upon reaching biological ripeness, the fruits were harvested and subjected to laboratory analysis to determine their biochemical composition. Key parameters measured included dry substance content, ascorbic acid (vitamin C) levels, mono- and disaccharide content, and nitrate levels. The spiciness of the fruits was also assessed using organoleptic methods, which involve evaluating the sensory attributes such as taste and heat intensity. The statistical analysis of the data was performed using Microsoft Excel, following the dispersion analysis method outlined by B.A. Dospekhov.

Each hot pepper sample was analyzed for its biochemical constituents under controlled laboratory conditions to ensure accuracy and reproducibility of the results. The collected data were compared against the control variety, Margilon 330, to identify significant differences and trends. This methodological approach provided a detailed and systematic assessment of the biochemical properties of various hot pepper cultivars, enabling the identification of superior varieties with enhanced nutritional and agronomic traits. The findings from this study contribute to the broader understanding of hot pepper cultivation and its potential for improving crop quality and yield in greenhouse settings.

3. Results and Discussion

The biochemical composition of hot pepper fruits only during biological ripening, i.e. the amount of dry substance, ascorbic acid, degree of spiciness, mono- and disaccharides, nitrate content was determined in laboratory conditions.

Table 1. Biochemical composition of fruits of hot pepper variety samples grown under greenhouse conditions

№	Cultivars and samples	Dry substance	Ascorbic acid, (vitamin C)	Mono and disaccharides	$N–NO_3$	Spiciness

		%	Мг	%	мг/кг	балл
1	Margilon 330 (cntl)	59,9	143,7	5,3	116,0	7,0
2	Uchqun	61,1	144,8	6,4	118,1	7,0
3	Tillarang	63,1	145,4	7,0	120,0	6,0
4	Said	56,2	136,2	5,1	112,3	7,0
5	Qoqon	50,3	139,1	4,3	114,4	7,0
6	Shakira	63,4	148,3	7,3	125,0	5,0
7	Landung	49,2	135,4	4,4	109,0	7,0
8	Madun	48,4	140,3	4,3	95,4	5,0
9	Batalion	50,1	139,2	4,0	98,3	5,0
10	Kastillo	46,4	133,4	5,0	99,1	5,0
11	Serambi	47,3	143,7	5,2	108,2	7,0
12	Megator	64,3	146,1	6,3	122,4	7,0
13	Genie	56,1	125,4	4,1	109,1	6,0
14	Balebat	63,4	143,6	7,2	124,0	7,0
15	14p4842(BB)	55,3	130,1	4,0	90,1	4,0
16	КЛ–99	47,1	131,3	3,4	109,4	7,0
17	КЛ–94А	52,3	134,0	3,3	107,3	7,0
18	КЛ–82	51,2	130,2	3,1	106,3	7,0
19	Dilnoz 2019	50,4	142,1	4,3	113,1	7,0
20	КЛ–211	54,3	140,3	4,4	110,3	7,0
21	Niyat	57,1	140,0	3,4	106,0	7,0
22	КЛ–202	56,3	139,1	4,1	105,4	5,0
23	Sharq gavhari	65,1	143,7	7,8	103,2	7,0
24	КЛ–98	48,3	133,0	3,9	112,1	7,0
25	КЛ–204	57,1	143,7	4,6	107,2	7,0
26	КЛ–210	47,3	129,3	4,8	108,4	7,0
27	КЛ–201	49,2	130,2	3,8	109,3	7,0
28	SHinpae Jang	53,2	134,3	3,2	97,4	5,0
29	Tanenang	54,2	130,3	3,1	93,4	5,0
30	Hot Asia	55,3	131,1	3,0	97,3	3,0
31	Shin Tang Vold	48,4	134,2	3,7	96,4	4,0
32	Internit	53,2	130,2	4,4	95,1	4,0
33	Asia Jungbo	58,0	136,0	3,7	92,1	4,0

34	23–C94	46,1	128,3	3,0	89,3	3,0
35	PR CHeongya	47,0	129,4	3,6	91,2	3,0

The biochemical composition of the fruits of hot pepper variety samples grown in an unheated greenhouse differed considerably. The dry matter content of the fruit of the control variety Margilon 330 was 59.9 percent and the samples 23-C94, "Kastillo", "Serambi", "PR CHeongya", KЛ-210, KЛ-99, "Madun", KЛ -98, "Shin Tang Vold, KЛ -201, Sharq gavhari and Landung had less dry matter by 10.7-13.8%, respectively, the amount of dry substance in the samples of varieties "Uchqun", "Tillarang", "Shakira", "Megator", "Balebat", “Sharq gavhari” was higher than the control variety from 1.2% to 5.2%. "Said", "Qoqon", "Landung", "Madun", "Batalion", “Kastillo”, "Serambi", "Genie", 4p4842(BB), KЛ–99, Dilnoz 2019, KЛ-82, DILNOZ 2019, KЛ–211, Niyat, KЛ–202, KЛ–98, KЛ–201, KЛ–204, KЛ-210, "SHinpae Jang", "Tanenang", "Hot Asia", "Shin Tang Wold", "Internit", "Asia Jungbo", 23-C94, "PR CHeongya" variety samples had a dry substance content from 1.9% to 13.8% less than the control variant. Ascorbic acid was found to be 143.7 milligrams in the control variety Margilon 330, while it was found that the ascorbic acid was 1.1-4.6 milligrams high in the "Uchqun", "Tillarang", "Megator", "Shakira" cultivars. "Said", "Qoqon", "Landung", "Madun", "Batalion", “Kastillo”, "Serambi", "Genie", "Balebat", 4p4842(BB), KЛ–99, Dilnoz 2019, KЛ -82, DILNOZ 2019, KЛ-211, Niyat, KЛ-201, KЛ-202, “Sharq gavhari” , KЛ-98, KЛ-204, KЛ -210, “Shinpae Jang”, “Tanenang”, “Hot Asia”, “Shin Tang Vold”, "Internit", "Asia Jungbo", 23-C94, "PR CHeongya" variety samples were found to have less ascorbic acid up to 3.4-18.3 milligrams.

When the degree of spiciness was determined by the orgonoleptic method, the control Margilon 330 variety had 7 points, while "Said", "Uchqun", "Shakira", "Qoqon","Landung", "Serambi", "Balebat","Megator", KЛ-99 , DILNOZ 2019, KЛ-82, KЛ-211, Niyat, KЛ-201, KЛ-202, “Sharq gavhari”, KЛ-98, KЛ-204, KЛ-210 were equal to the variety samples. “Madun”, “Batalion”, “Kastillo”, “Genie”, 14p4842(BB), “SHinpae Jang”, “Tanenang”, “Hot Asia”, “Shin Tang Vold”, “Internit”, “Asia Jungbo”, 23-C9423, "PR CHeongya" variety samples showed that the amount of spiciness was 3-6 points higher than the control variety.

The spiciness degree or capsaicin content was 5 points in the control variety, 1 point in the 23-C94 sample, and 2 points in the "PR CHeongya" cultivar. It was found that the "Tillarang" cultivar had 4 points,

and the rest of the samples were the same as the control variety in terms of spiciness. The content of capsaicin or the degree of spiciness in hot pepper fruit was measured organoleptically. In our research, the degree of spiciness of hot pepper was determined by the organoleptic (view, smell, taste) method. The amount of mono- and disaccharide in the fruit was 5.3% in the control variety, while in the samples "Tanenang", "Hot Asia", "SHinpae Jang", K*Л*-82, K*Л*-99, Dilnoz 2019, Niyat, K*Л*-98, and K*Л*-201 it was 3.0–3.9 or 1.4–2.9% less than the control. In the "Qoqon", "Landung", "Madun", "Batalion", "Genie", 14p4842(BB), Dilnoz 2019, K*Л*-211, K*Л*-202, K*Л*-204, K*Л*-210, "Internit" samples it was between 4.0-4.8%, while the cultivars "Said", "Kastillo", "Serambi" were close to the control variety in this regard.

Nitrates in vegetable fruits are dangerous for human health. For an adult weighing 70 kg, 700 mg of nitrates have been found to be harmful. This amount should be 10 milligrams per 1 kg of weight for adults and 4-5 milligrams for children. The World Health Organization has defined the limit of permissible concentration as 260 mg for nitrates and 15 mg for nitrites (A.S. Bolotskikh, 1998). For CIS countries, their amount is set at 120-180 mg/kg for crops grown in open ground, especially hot pepper.

The amount of nitrates depends on the degree of ripeness of the fruit. In raw unripe fruits, their amount is more than in ripe ones. These data confirm the high accumulation of nitrates in early-harvested potato tubers, carrots, lettuce, and other leafy vegetables. The amount of nitrates in vegetables depends on their size, weight and time of harvest. The highest amount of nitrates in vegetables during the day was noted between 5 a.m and 9 o'clock a.m and 9 p.m and 12 a.m. Therefore, it is better to pick vegetables in the late afternoon or early morning.

In our research, the amount of nitrates in the control variety Margilon 330 was 116.0 mg/kg, while the amount of nitrates in the cultivars "Uchqun", "Tillarang", "Shakira", "Balebat", "Megator" was found to be higher from 2.1 to 8.0 mg/kg than the control. In the "Said", "Qoqon", "Landung", "Madun", "Batalion", "Kastillo", "Serambi", "Genie", 14p4842(BB), K*Л* -99, Dilnoz 2019, K*Л* -82, K*Л* -211, Niyat, K*Л* -201, K*Л* -202, Sharq gavhari, K*Л* -98, K*Л* -204, K*Л* -210, "SHinpae Jang", "Tanenang", "Hot Asia", "Shin Tang Wold", "Internit", " Asia Jungbo", 23-C94, "PR CHeongya" variety samples, nitrate content was lower than the control variety by 1.6-24.8 mg/kg. According to A.S. Bolotskikh, the nitrate content of pepper fruit is in the minimum and maximum range, and it is proved in our research also that it is an acceptable degree.

4. Conclusion

The findings of this study reveal significant variations in the biochemical composition of 35 varietal samples of hot pepper (Capsicum annuum L.) grown under greenhouse conditions, with specific cultivars demonstrating higher levels of dry substance, ascorbic acid, mono- and disaccharides, and spiciness compared to the control variety, Margilon 330. Notably, cultivars such as Uchqun, Tillarang, and Shakira exhibited superior nutrient profiles, suggesting their potential for breeding programs aimed at enhancing nutritional quality and agronomic performance. The research underscores the importance of selecting and cultivating hot pepper varieties with optimal biochemical traits to improve crop yield and quality in greenhouse settings. These findings have significant implications for agricultural practices, particularly in the context of developing high-yield, nutrient-rich hot pepper cultivars that are resilient to environmental stresses. Further research is recommended to explore the genetic basis of these biochemical traits and to assess the long-term performance of the identified superior cultivars in diverse growing conditions.

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