Studii şi Cercetări	Martie 2017	Biologie	26/1	15-18	Universitatea"Vasile Alecsandri" din Bacău

DOCUMENTATION, EVALUATION, AND USE OF HOT PEPPER FRUITS *CAPSICUM ANNUUM* VAR. *ACCUMINATUM* IRISH AS MEDICINAL SPECIES

Creola Brezeanu, Silvica Ambarus, Petre Marian Brezeanu, Teodor Robu, Aurelia Dobrescu

Key words: *morphological characterization, antioxidant potential*

INTRODUCTION

Peppers had spread around the world and today constitute the defining ingredient in traditional cuisines worldwide, including countries such as Italy, Thailand, Hungary, India, Spain, China and Holland. Botanically, most cultivated peppers today are *Capsicum annuum* (most common), *C. frutescens* (tabasco), *C. chinense* (habanero), or crosses within and among these various species. Peppers and other spices have long been used to color, flavor and preserve foods, as well as for medicinal purposes. (Chopan 2017).

Hot pepper is an important agricultural crop, especially thanks to its nutritional and medicinal value of fruits. These are the excellent source of natural colors and antioxidant compounds (Howard *et al.*, 2000). A wide spectrum of antioxidant vitamins, carotenoids, capsaicinoids and phenolic compounds are present in hot pepper fruits. The intake of these compounds in food is an important health-protecting factor by prevention of widespread human diseases.

As consumption continues to increase, hot peppers could provide important amounts of nutritional antioxidants to the human diet. Levels of these antioxidants can vary according to genotype, stage of harvest/maturity and plant part consumed as well as storage and processing conditions (Daood et al., 1996 and Marin et al., 2004). Maturation affects pepper color, shape and capsaicin level changes continuously. Important nutrients like ascorbic acid and provitamin A increased from green stage to the red stage (Howard et al., 1994 and Sidonia et al., 2005).

This study was performed in frame of ADER 2020 project, entitle: "Regeneration, multiplication and characterization of some traditional vegetables resources". The main purpose was to regenerate a collection *Capsicum annuum* var. *accuminatum* Irish. in order to detect the most valuable resources for breeding programs. This work presents the results accomplished in our investigation of twelve valuable accessions of hot pepper. There are also presented information related to potential use of this species as medicinal plant.

MATERIAL AND METHODS

The experiments were conducted at the Vegetable Research and Development Station in Bacau, Romania.

The biological material - was represented by twelve hot pepper genotypes.

The study included phenologically and morphological investigations in order to detect the length of vegetation period, type of growth, shape, color and size of fruits, number of fruits per plant, number of seeds in fruit, yield potential.

The physiological investigations were accomplished in order to detect the antioxidant potential and other physiological parameters as follows: total dry mater, minerals.

In order to evaluate the chili peppers antioxidant potential, there were made investigations related to ascorbic acid content, anthocians and carotene content. The methods used in our investigations were:

Estimation of the dry matter – in this purpose 200g red ripe fruits were randomly collected from different replications at red ripe stage, dried to constant temperature of $65 \pm 2^{o}C$ in an oven (for 3-4 days) until constant weight was achieved and their dry weights were recorded.

The most important pigment, responsible for orange color (β carotene), was extracted with petrol ether and determined at spectrometer at λ=415 nm. The content of β carotene was expressed in mg/100g.

The anthocians were detected in methanol extract and then spectrophotometrically investigated ant the contents were expressed in mg/100g.

Ascorbic acid content (mg/100g fresh sample) was determined by 2, 6-dichlorophenolindophenol method, as described by Sadasivam and Theymoli (1987), where in oxalic acid was used as titrating medium.

Screening of potential use as medicinal plant represents a compilation between a literature review and a collection of traditional information.

According to that information chili are suitable to be used in different areas as food industry, medicinal products, cosmetic, etc, based on its chemical profile.

RESULTS AND DISCUSSIONS

Taking in consideration similar applied technology and same environmental condition our phenologically investigation highlighted a variation in terms of number of days for each phenophases for each investigated genotype. The shortest vegetation period was registered at genotype HP 7 and the longest at genotype HP 10 (Table 1). The morphological investigations were performed in order to analyze: type of growth, shape, color and size of fruits, number of fruits per plant, number of seeds in fruit, yield potential.

Table 1. The main phenophases of hot pepper investigated genotypes

Phenophase	HP 1	HP 2	HP 3	HP 4	HP 5	HP 6	HP 7	HP 8	HP 9	HP 10	HP 11	HP 12
sowing - springing	10±1	13±1	11±1	11±1	10 ±1	12±1	10±1	10±1	11±1	13±1	12±1	11±1
springing – planting time	50±1	48±1	50±1	49±1	50±1	49±1	48±1	49±1	50±1	50±1	49±1	50±1
planting time -flowering	12±1	14±1	14±1	14±1	13±1	12±1	12±1	13±1	14±1	14±1	12±1	13±1
first fruit appearance	4±1	3±1	4±1	4±1	4±1	3±1	3±1	4±1	4±1	4±1	3±1	4±1
first fruit appearance - harvesting	59±4	62±3	63±4	63±2	60±3	59±4	60±2	60±3	63±3	64±4	62±4	63±5
vegetation period springing - last harvest	121±4	124±3	127±4	126±3	123±2	120±2	120±2	122±2	127±3	128±3	123±1	126±3

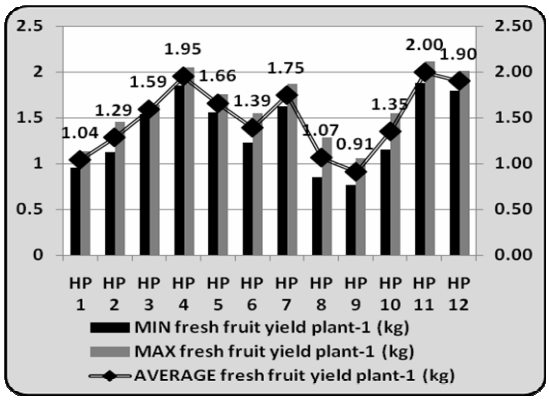

Fig. 1. Fresh fruit yield kg plant^{-1}

The average fresh fruit yield, registered a variation between 0.91 kg plant^{-1} at genotype HP 9 to 2 kg plant^{-1} at genotype HP 11. Superior values of fruit yield, more than 1.5 kg plant^{-1} was obtained by genotypes: HP 3 (1.59), HP4 (1.95), HP5 (1.66) HP 7 (1.75) and HP 12 (1.90) kg plant^{-1}.

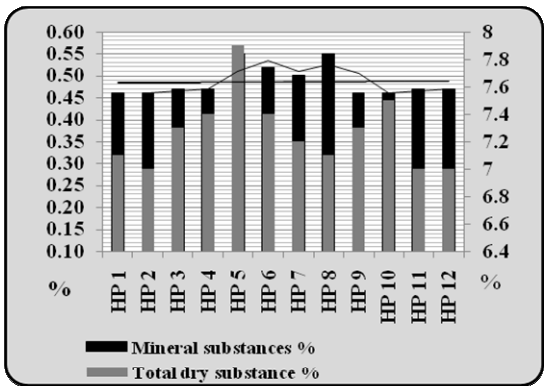

Fig. 2. Variation of minerals and total dry substances in maturated hot pepper fruits

According to our expertise, investigated genotypes exhibits variable levels of antioxidant capacity, expressed by ascorbic acid content, anthocians and carotene content. These components that contribute to a high antioxidant activity and may be considered as a good source of natural antioxidants.

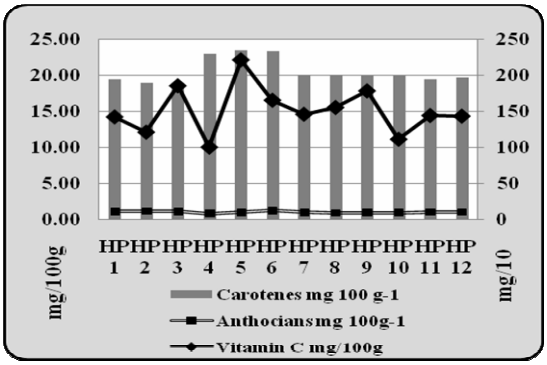

Fig. 3. Variation of β carotene and anthocians in maturated hot pepper fruits

The highest β carotene content, 23.47 mg 100 g^{-1} was registered at genotype HP 5. In case of anthocians the variation was from 0.8 mg 100 g^{-1} at HP 4 to 1.15 mg 100 g^{-1} at genotype HP 2. The degree of pungency of hot peppers varies based on the cultivars, origins, growing conditions, and drying conditions.

Regarding the Vitamin C content, the registered variation was from 100.25 mg 100 g^{-1} at HP 4 to 185.32 mg 100 g^{-1} at HP 3

Traditional medicinal use in our region

Use of plants with a strong medicinal potential and their active components is becoming an increasingly attractive approach for the treatment of various inflammatory disorders. According to screened literature and also with our investigation, the pepper cultivars studied have levels of phenolic constituents that contribute to a high antioxidant activity and may be considered as a good source of natural antioxidants. The antioxidant capacity is frequently correlated with the highest levels of total phenols and flavonoids. Some compounds (e.g. ascorbic acid, carotenes, anthocians) present in the peppers could improve the antioxidant activity.

Capsaicin is currently used for the treatment of diabetic neuropathy, osteoarthritis, post-herpetic neuralgia, and psoriasis (Jin et al., 2009), as well as there are many patents on insecticides, insect or animal repellents, and pesticides containing capsaicinoids (Eich, 2008).

Pepper fruits also possess other molecules, which are beneficial to humans, such as vitamins C and A, and carotenoid pigments with antioxidant activities (Zhuang et al., 2012). Vitamin C is an important antioxidative vitamin that is essential for maintaining a healthy immune system, building healthy connective tissue, bones and teeth, healing wounds and fractures. Among the carotenoid pigments, capsanthin and capsorubin are known to be exclusive of the genus *Capsicum* and are responsible for the final red fruits, while the green color of the fruit is principally due to the presence of chlorophyll, typical of the chloroplast, and in minor extent to carotenoids and xanthophylls (De Masi et al., 2007).

Other classes of phenylpropanoid derivatives, which are non-pungent analogues of the former one possessing similar biological effects, have been recently described: capsinoids, and capsiconinoids (Tanaka et al., 2009). For these motives *Capsicum* extracts have been used in medicine as previously reported and, recently, even in cosmetics (Hayman et al., 2008, Luo et al., 2011). Adjuvant in digestive discomfort - contrary to the perception that chili makes worse to the stomach, it seems that the results of studies show the opposite. Capsaicin is one that increases blood flow, so that, once in the stomach region, it will cause stimulating the production of gastric juice, which helps to relieve heartburn and stomach cramps. Chili stimulates hair growth and hair follicle strength. Moreover, hot pepper is often used in hair cosmetics that help to combat alopecia or baldness. The effect of heating on skin created by paprika is known by everyone. Thus, by stimulating blood circulation, the skin receives more nutrients, become better oxygenated and metabolism is improved. This way is normalized sebaceous secretion stimulated hair growth, strengthened their root, normalized metabolism in the scalp and hair look better. Local analgesic (applied to relieve pain and swelling) - capsaicin extract can be applied to the affected area but carefully due to very hot burns that can cause severe irritation. The pepper chili has an analgesic effect for rheumatic pain, toothache, impaired peripheral circulation.

Table 2. Proximate chemical composition of chili pepper, according to literature

Parameter	Variation		Reference
	minim	maxim	
Moisture (g/kg)	54.8±0.8	130±19.4	(Orellana- Escobedo, 2013)
Dry mater (%)	15.61	67.14	(Pandey, 2014)
Ash (g/kg)	58.1±0.7	95.4±2.4	(Orellana- Escobedo, 2013)
Protein (g/kg)[2]	120.5±0.0	152.2±5.1	(Orellana- Escobedo, 2013)
Fat (g/kg)	22.6±1.3	137.6±2.6	(Orellana- Escobedo, 2013)
Carbohydrates (g/kg)	576.8±11.4	676.3±8.1	(Orellana- Escobedo, 2013)
Vitamin C (mg/100g)	13.28	225.76	(Pandey, 2014)
Capsaicin (%)	0.10	1.47	(Pandey, 2014)
Oleoresin (%)	7.20	17.40	(Pandey, 2014)
Extractable colour (ASTA)	53.30	294.38	(Pandey, 2014)
Colour value (c.u.)	20790	116160	(Pandey, 2014)
Capsaicin (%)	37.22	40.85	(Wesołowska, 2011)
Dihydrocapsaicin (%)	19.87	28.68	(Wesołowska, 2011)
Vitamin E (%)	1.98	2.10	(Wesołowska, 2011)

CONCLUSIONS

The information presented in this study can help promote the consumption and use of hot peppers in food industry and also in medicinal propose. We observed a strong influence of genotype on the antioxidant activity. Similar technology and same environmental condition conduct at different antioxidant potential according to investigated germplasm. Chili peppers have a wide range of uses, including pharmaceutical, natural coloring agents and cosmetics, as an ornamental plant, and as the active ingredient in most defense repellants (i.e. pepper sprays).

ABSTRACT

The value of the hot pepper species is given by its food and therapeutic role, due to the complexity and diversity of biochemical constituents. Worldwide, the species enjoys increasing attention and is the subject of numerous physico-chemical,

agrobiological and pharmacological research. The study presents the results obtained through the investigations carried out on a collection of hot peppers under the ADER 2020 project "Regeneration, multiplication and characterization of traditional plant resources". Our investigations have assumed phenological observations, biometric measurements and physiological determinations, in order to evaluate valuable germplasm resources to be introduced into amelioration programs.

REFERENCES

1. CHOPAN M., LITTENBERG B., 2017 - The Association of Hot Red Chili Pepper Consumption and Mortality: A Large Population-Based Cohort Study. https://doi.org/ 10.1371/ journal.pone.0169876;
2. HOWARD L.R., TALCOTT S.T., BRENES C.H., VILLALON B., 2000 - Changes in phytochemical and antioxidant activity of selected pepper cultivars (*Capsicum* sp.) as influenced by maturity. Journal of Agriculture and Food Chemistry, 48, 1713-1720;
3. DAOOD H.G., VINKLER M., MARKUS F., HEBSHI E.A,. BICAS P.A., 1996 - Antioxidant vitamin content of spice red pepper (paprika) as affected by technological and varietal factors. Food Chemistry, 15(4), 365-372;
4. MARIN A., FERRERES F., TOMAS-BARBERAN F.A., GILL M.I., 2004 - Characterization and quantitation of antioxidant constituents of Sweet pepper (*Capsicum annuum* L.). Journal of Agriculture and Food Chemistry, 53, 3861-3869;
5. HOWARD L.R., SMITH R.T., WAGNER A.B., VILLALON B., BURNS E.E., 1994 - Provitamin A and ascorbic acid content of fresh pepper cultivars (*Capsicum annuum* L.) and processed jalapenos. Journal of Food Science, 59, 362-365;
6. SIDONIA M., LOPEZ M., GONZALEZ-RAURICH M., ALVAREZ A.B., 2005 - The effect of ripening stage and processing systems on vitamin C content in sweet peppers (*Capsicum annuum* L.). International Journal of Food Sciences and Nutrition, 56(1), 45-51;
7. SADASIVAM S., THEYMOLI B., 1987 - *Practical Manual in Biochemistry* Tamil Nadu Agricultural University Coimbatore India;
8. JIN R., PAN J., XIE H., ZHOU B., XIA X., 2009 - Separation and Quantitative Analysis of Capsaicinoids in Chili Peppers by Reversed-Phase Argentation LC. Chromatographia, 70 (5–6), 1011;
9. EICH E., 2008 - *Solanaceae* and *Convolvulaceae:* Secondary Metabolites. Springer, Germany, 282–292;
10. ZHUANG Y., CHEN L., SUN L., & CAO J. 2012 - Bioactive characteristics and antioxidant activities of nine peppers. *J. Funct. Foods*, *4*, 331–338;
11. DE MASI L., SIVIERO P., CASTALDO D., CAUTELA D., ESPOSITO C., & LARATTA B., 2007 - Agronomic, chemical and genetic profiles of hot peppers *(Capsicum annuum ssp.)*. Molecular Nutrition & Food Research., vol. 51, 1053–1062;
12. TANAKA Y., HOSOKAWA M., OTSU K., WATANABE T., YAZAWA S., 2009 - Assessment of Capsiconinoid Composition, Nonpungent Capsaicinoid Analogues, in Capsicum Cultivars. Journal of Agricultural and Food Chemistry, 57, 5407–5412;
13. HAYMAN M., KAM P.C.A., 2008 - Capsaicin: A review of its pharmacology and clinical applications. Current Anaesthesia & Critical Care, 19, 338–343;
14. LUO X. J., PENG J., LI Y. J., 2011 - Recent advances in the study on capsaicinoids and capsinoids. European Journal of Pharmacology, 650, 1–7;
15. ORELLANA-ESCOBEDO L., GARCIA-AMEZQUITA L.E., OLIVAS G.I., 2013 - Capsaicinoids content and proximate composition of Mexican chili peppers (Capsicum spp.) cultivated in the State of Chihuahua – CyTA. Journal of Food,11, (2), 179-184;
16. OMOLO M.A., WONG Z., MERGEN A.K., 2014 -Antimicrobial Properties of Chili Peppers. Journal of Infect. Diseases & Therapy, 2, 145;
17. PANDEY K.H., MAHALINGAN K., SHARMA S.,-Antioxidant properties of various fruits, herbs, spices and vegetables: World Journal of Pharmacy and pharmaceutical sciences Vol 3 Issue 2, 1101 – 1109;
18. WESOŁOWSKA A., JADCZAK D., GRZESZCZUK M., 2011 - Chemical composition of the pepper fruit extracts of hot cultivars *Capsicum annuum* L. Acta Scientiarum Polonorum-Hortorum Cultus, 10 (1), 171-184.

ACKNOWLEGMENTS

This work was co-financed from the Sectorial program ADER 2020, VRDS Bacau projects.

AUTHORS' ADDRESS

BREZEANU CREOLA, AMBARUS SILVICA, BREZEANU PETRE MARIAN - VRDS Bacau, Calea Barladului, Street, no. 220, e-mail: creola.brezeanu@yahoo.com;

ROBU TEODOR – University of Agricultural Science and Veterinary Medicine, Iasi, 3, Mihail Sadoveanu Alley, Iaşi;

DOBRESCU AURELIA - University of Agricultural Science and Veterinary Medicine, Bucuresti, Marasti 54 Bucuresti, Romania.