

## EVALUATION OF SOME CUCUMBER HYBRIDS (*CUCUMIS SATIVUS* L.) FOR QUALITY TRAITS

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### Abstract

Cucumber (*Cucumis sativus* L.) is a species of the Cucurbitaceae family cultivated mainly in protected areas in Romania. Cucumber fruits are sources of nutrients necessary for human health, and awareness of quality attributes can satisfy the demands of consumers who are becoming more informed lately. The aim of the study was to analyze of some quality indices in two hybrids of cucumbers, Amour F1 and Capricorn F1 grown in solar, on a soil mulched with black polyethylene film. The quality analyzes were performed immediately after harvesting, at technological maturity and were focused on: pH, titratable acidity, SSC, reducing sugars, glucose, fructose, ascorbic acid, total phenolics and flavonoids content. The results showed that the hybrid Amour F1 recorded higher values in terms of content in SSC, ascorbic acid and total phenolics and in mulched variants compared to the variants without mulching.

**Key words:** fruit quality, cucumbers, mulched, phytochemicals

### INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a species of the Cucurbitaceae family cultivated in all regions of the world on an area of 2172193 ha in 2021 and an annual production of 93528796 t in 2021 (Faostat, 2023). Cucumbers are consumed all over the world as fresh or processed vegetables, due to their pleasant and refreshing taste and their content of essential nutrients and antioxidant-rich phytochemicals. Also, cucumber fruits are rich in water and very low in calories.

In nutrition, fruits are often used as cooling vegetables. However, with the constant change in the environment and cultivation techniques and the ever-increasing living standards of people, the quality of cucumber fruit is becoming concern by for consumers (Zhang, 2021).

Cucumbers (*Cucumis sativus*) possess antibacterial, antimicrobial, antioxidant,

phytochemical and hypoglycemic properties (Shah et al., 2013). Plants of the genus *Cucumis* show useful therapeutic effects for osteoarthritis, ulcerative colitis and wound healing. Every part of the plants in the genus *Cucumis* contains phytochemical compounds (Insanu et al., 2022). Cucumber seed oil can play a vital role, if used in drug, food or cosmetic formulations, to prevent some diseases such as inflammation, bacterial infection, fever (Agatemor et al., 2018). The quality of cucumber fruits can be defined by several aspects, namely, commercial quality, aroma and nutritional quality. The commercial quality of cucumbers refers to the size and shape of the fruit and the characteristics of the fruit peel. On the other hand, the quality of the fruits is also given by the nutritional elements, such as solids soluble substance, vitamins, minerals and the presence of some

phytochemical compounds. The nutritional compositions of *Cucumis sativus* include proteins, fats and carbohydrates as primary metabolites, along with dietary fibers that are important for the digestive system. Phytochemicals are secondary metabolites produced by plants. These products are biologically active chemicals that occur naturally in various parts of plants, providing health benefits to humans. Consumers are increasingly interested in nutritionally rich vegetable varieties/hybrids. With the development of society, people's demand for quality cucumbers is getting higher and higher.

A basic factor in improving the quality of cultivated plants is the value and diversity of biological material, which must be rich in quality genes or genotypes (Păniță et al., 2020). The use of plastic mulch in horticulture has increased greatly in recent years worldwide. This increase is due to the benefits brought to the plants, such as the increase in the temperature of the soil, the reduction of the number of weeds and the attack of some pests, the conservation of humidity, early and the increase in the quantity and quality of production. Melons and other cucurbit crops benefit from mulching in an open field, with tunnels and greenhouses, useful for obtaining early yields and fruit quality (Cozzolino et al., 2023). For greenhouse cucumber crops in a conventional system, the soil needs to have a light texture to ensure aeration of the roots and good drainage, such as mineral wool as nutrient substrate of crops (Becherescu et al., 2016; Petre et al., 2015). Applying mulching treatments increased yields and fruit quality to sweet potato as well (Dinu et al., 2022; Hector et al., 2015;), physalis (Helaly et al., 2017), watermelons (Singha et al., 2023), and lettuce (Tiru et al., 2018), etc. Therefore, the aim of the study was phytochemical

characterization at two hybrids of cucumbers, grown in solar, using mulching and non-mulching systems.

## **MATERIALS AND METHODS**

The experience was located in the didactic field of the Faculty of Horticulture and Agriculture, University of Craiova, in the south-west of Romania, in the years 2018-2019. The biological material was represented by two cucumber hybrids: Amour F1 and Capricorn F1. Amour F1 is a cornichon hybrid, with a vegetation period of 75 days and good productivity. The plants are vigorous and the fruits are firm, slightly curved, of uniform green color.

Capricorn F1 is a cornichon hybrid, productive and resistant to diseases, and the fruits are uniform and have spines.

For the establishment of the culture, seedlings were planted after 45 days, in an unheated greenhouse, in the first decade of May. The planting distance was 90 cm between rows and 30 cm between plants per row.

The planting distances were 90 cm between rows and 30 cm between plants per row. During the vegetation period, the conventional culture technology specific to cucumbers was applied, in two versions: with black polyethylene mulch and without mulch. To determine the physico-chemical quality parameters, analyzes were carried out regarding: dry matter, soluble substance content, titratable acidity, pH, ascorbic acid, total phenolics and flavonoids.

Analytical methods: The dry matter content (DM %) was determined gravimetrically by sample drying to a constant temperature at 105°C.

pH measurements of fruits juice are made using a calibrated pH tester at 25 °C HANNA Basic pH tester Checker.

Soluble solids content (SSC %) were determined using a digital refractometer

(Kruss Optronic DR 301-95) at 20°C and expressed as %.

The titratable acid (%) content was determined by titration with 0.1N sodium hydroxide (NaOH), using phenolphthalein as indicator and expressed as % malic acid. Reducing sugars content (%) were extracted in distilled water (1:40 g:mL), 60 minutes at 60°C and assayed colorimetric at 540 nm with 3,5 dinitrosalicylic acid reagent using glucose as standard. The results were expressed in % fresh weight basis.

Glucose (%) content was assayed at 500 nm by glucose oxidase/peroxidase method (GOD/POD). Glucose oxidase (GOD) is used to oxidize glucose by the oxygen in the air to gluconolactone and hydrogen peroxide. Under the influence of peroxidase (POD) the hydrogen peroxide reacts with colour indicator forming a pink compound. The glucose content was calculated from calibration curve using glucose (5 mg/mL) as standard.

Fructose content (%) is the difference of reducing sugars (%) and glucose (%).

Ascorbic acid (AsA) was extracted in 2% metaphosphoric acid, HPO<sub>3</sub>; 1:20 w/v. The determination of ascorbic acid is performed with 2,6-dichlorophenol indophenol in acid solution redox titration which involves reduction of this dye to a leucobase while ascorbate is oxidized to dehydroascorbate. The intensely colored 2,6-dichloroindophenol is quite specific in its ability to oxidize only vitamin C. This dye is dark blue in neutral and basic solutions and red in acidic solutions. During titration the solution stays colorless until all the ascorbic acid has been oxidized. After this point, further addition of 2,6-dichloroindophenol will turn the solution pink.

To calculate the results, several titrations of the standard ascorbic acid solution with

the dye solution of 2,6-dichloroindophenol are performed to determine the average of dye solution volume against standard ascorbic acid solution. The ascorbic acid content was expressed as mg/100 g fresh weight.

Methanolic extract: For the determination of total phenolic content and total flavonoids content samples were extracted with 80% aqueous methanol (1:20 w:v) by sonicating for 60 min in a sonicate bath Fungilab (Madrid, Spain) equipped with a digital timer and a temperature controller at 24°C. The resulting slurries were centrifuged at 4000 g for 5 min and the supernatants were analyzed.

The total phenolics content (TPC) was determined colorimetric at 765 nm by using the Folin-Ciocalteu reagent. The total phenolic content (TPC) was calculated using a standard curve prepared using gallic acid and expressed as mg GAE/100 g fw.

The total flavonoids content (TFC) was determined by colorimetric methods at 500 nm with chromogenic system of NaNO<sub>2</sub>-Al(NO<sub>3</sub>)<sub>3</sub>-NaOH (Soare et al., 2017). The total flavonoid concentration was calculated from quercetin calibration curve and expressed as mg Q/100g fw.

The spectrophotometric measurements were performed with a Thermo Scientific Evolution 600 UV-Vis spectrophotometer with VISION PRO software. All determinations were performed in triplicate, and all results were calculated as mean.

For the analysis of variance (ANOVA) the MS Excel software and the Duncan's Multiple Range Test at significance level of  $p < 0.05$ .

## RESULTS AND DISCUSSIONS

The investigated biochemical indices vary according to the analyzed cultivar and the variants with mulch or without mulch (Table

1). Dry matter content varies from 3.42% (Capricorn F1 -Without mulching) to 5.85% (Amour F1- mulching) and moisture from 94.15% (Amour F1) to 96.58% (Capricorn F1). Cucumbers have a high humidity which aids in digestion and acts as a solvent in chemical reactions in the body system.

Several authors have demonstrated that mulching with black polyethylene film can significantly improve dry matter accumulation in edible organs (Hernández-Aranda et al., 2021; Tiru et al., 2018).

Soluble solids content varies from 3.18% (Capricorn F1- without mulching) to 5.20% (Amour F1-mulching). Soluble solids

content (SSC) is a quality indicator for many vegetables that contribute to flavor perception and consumer acceptance. It is also an index that indicates the sweetness determined by the content of glucose, fructose and sucrose that contribute differently to the sweet sensation. TSS content may vary according to species, cultivar, and harvest time (Soare et al., 2020). It can be stated that mulch increases the accumulation of SSC, a fact supported by several authors. Thus, Dinu et al., (2022), reported on the sweet potato crop and Singha et al., (2023) reported high values in SSC on the watermelon crop.

**Table 1. Effect of mulching on Dry matter, SSC, red sugar, glucose and fructose of Cucumis fruit**

Variants	Cultivars	Content in:				
		Dry matter (%)	SSC (%)	Red sugar (%)	Glucose (%)	Fructose (%)
Without mulching	Amour F1	5.04b	4.55b	1.978c	0.876c	1.102c
	Capricorn F1	3.51d	3.18c	1.393d	0.732d	0.661d
Mulching	Amour F1	5.82a	5.20 a	2.543a	1.157b	1.386a
	Capricorn F1	4.47c	4.38b	2.234b	1.386a	1.202c
LSD 5%		0.15	0.21	7.8	6.06	8.9

Regarding the *reducing sugars* content determined in this study, the values were between 1.393% (Capricorn F1 - without mulching) and 2.543% (Amour F1-mulching). Reducing sugars present in cucumber fruits are glucose and fructose. In the studied hybrids, the content of glucose varies between 0.732% (Capricorn F1 - without mulching) and 1.157% (Amour F1- mulching) and the content of fructose is 0.661% (Capricorn

F1 - without mulching) and 1.386% (Amour F1- mulching).

The sugar accumulation is influenced by hybrids, technology, environmental conditions, soil quality and harvest time, which explains the differences between the results of other researches (Schlering et al., 2020). Shah et al., (2013), reports for the glucose and fructose content values of 0.63g /100g, respectively 0.75 g/100g.

**Table 2. Effect of mulching on pH, acidity, acid ascorbic polyphenols and total flavonoids of Cucumis fruit**

Variants	Cultivars	Content in:				
		PH	Total acidity (mg/g)	AsA (mg/100g)	TPC (mg/100g)	TFC (mg/100g)
Without mulching	Amour F1	5.72a	0.88d	2.02b	15.342b	2.310c
	Capricorn F1	5.78a	1.74b	1.54d	11.735d	2.080d
Mulching	Amour F1	5.8a	1.18c	2.54a	17.683a	2.460b
	Capricorn F1	6.0a	2.02a	1.97c	14.812c	2.584a
LSD 5%		0.35	6.33	3.68	6.43	3.75

Cucumber fruits have a pH between 5.72 (Amour F1 - without mulching) and 6.0 (Capricorn F1- mulching) as shown in Table 2, the pH being slightly acidic which is advantageous for their consumption because it does not add acidity to the gastric juice.

Values for total acidity vary between 0.88 mg/g (Amour F1- without mulching) and 2.02 mg/g (Capricorn F1- mulching). These values were influenced both by the hybrid and by the variantes with or without mulch. The acidity is determined by the content in organic acids, by the cultivars and the applied technology. Several authors have shown an increase in total acidity also in other species cultivated under mulching conditions (Helaly et al., 2017; Abdalla et al., 2019). Regarding the content in organic acids, Schlering et al., (2020) find that malic acid is the predominant acid in cucumber fruits, followed by fumaric acid 37.6mg/100g fw and by ascorbic acid 7.2 mg/100g fw while, citric acid was not detected.

In the present study, the content of ascorbic acid is 1.54 mg/100g fw (Capricorn F1 - without mulching) and 2.54 mg/100g fw (Amour F1- mulching). An increased accumulation of vitamin C was observed in the cucumber fruits depending on the hybrid and the variantes with mulch, compared to the variantes without mulch. Other

researchers have stated that plastic mulch determined a better accumulation in vitamin C. Ashrafuzzaman et al., (2011) reported that black mulches produced higher vitamin-C content in chilli, Dinu et al., (2022) reported on the sweet potato crop and Abdalla et al., (2019) at strawberry culture.

Ascorbic acid is one of the most important water-soluble vitamins, naturally present in fruits and vegetables.

The content of total phenolic compounds (TPC) and the content of total flavonoids (TFC) vary between 11.735 mg GAE/100g fw (Capricorn F1- without mulching) and 17.683 mg GAE/100g fw (Amour F1- mulching), respectively between 2.080 mg QE/100g fw (Capricorn F1- without mulching) and 2.584 mg QE/100g fw (Capricorn F1- mulching) as shown in Table 2. It was observed that the variation of this content depended and the hybrid and technological sequence, Amour F1 recording higher values. This statement is also supported by Dinu et al., (2022), at sweet potato.

Cucumber fruits contain important secondary metabolites including flavonoids and polyphenols, being identified over 73 compounds (Abu-Reidah et al., 2012). These are powerful antioxidants that can scavenge free radicals, inhibit lipid oxidation, or chelate metal ions. The results in the present

study for TPC are in agreement with data from the scientific literature: 15.9 mg/100g fw for cucumber F1 hybrid cv. 'Fuga F1' (Schlering et al., 2020); 188 µgGAE /g fw for variety Induran RZ F1 (Cid-Lopez et al., 2021).

## CONCLUSIONS

The nutrient content of cucumber fruits was improved by applying the mulching

compared to without mulching plants. Among the hybrids, Amour F1 had a higher content of soluble solids, vitamin C and total phenols compared to the Capricorn F1 hybrid. Therefore, cucumber growers should use black plastic mulch for the advantages it offers and on production quality.

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