Res. on Crops **20** (2) : 369-375 (2019) DOI : 10.31830/2348-7542.2019.054
With one figure
Printed in India

Production of cucumber (*Cucumis sativus* var. *conomon*) juice

NGUYEN PHUOC MINH*

Faculty of Natural Sciences
Thu Dau Mot University, Binh Duong Province, Vietnam
**(e-mail : nguyenphuocminh@tdmu.edu.vn)*

(Received : May 29, 2019/Accepted : June 21, 2019)

ABSTRACT

Cucumber (*Cucumis sativus* L.) is the most important crop of the family Cucurbitaceae grown commercially throughout the world. Cucumber is extremely beneficial for overall health; it could relieve thirst as it is mostly made of water and important nutrients that are essential for the human body. There is increased consumption of *C. sativus* fruits possibly because of their high nutritional value. The nutritional compositions of *C. sativus* include protein, fat and carbohydrate as primary metabolites; along with dietary fibre which is important for the digestive system. However, it softens very rapidly during ripening and becomes mushy and difficult to consume fresh. Freshly expressed juice is highly susceptible to spoilage, in fact more so than whole fruit. In the present study, various technical parameters influencing production of cucumber var. *Conomon* juice were clearly investigated such as ratio of flesh : water, sugar supplementation during the blending process; pasteurization, storage condition to stability of cucumber juice. This research was conducted during 2017-18 in the Scientific Laboratory of Global Food Technology Ltd. Optimal results showed that ratio of flesh : water (1.0 : 2.5 w/v); 10% of sugar supplementation; 95°C, 30 sec in pasteurization; 28°C of preservation could maintain stability of cucumber juice for 12 weeks.

Key words : Cucumber, juice, pasteurization, preservation, shelf life, sugar

INTRODUCTION

Cucumber (*Cucumis sativus* var. *conomon*) belongs to Curcurbaticeae family. It is one of the monoecious annual crops (Hina Saeed and Anam Waheed, 2018). It is a creeping vine which bears cylindrical edible fruit when ripe. Cucumbers actually come in a wide variety of colours, sizes, shapes and textures. There are white, yellow and even orange-coloured cucumbers, and they may be short, slightly oval, or even round in shape. Their skins can be smooth and thin, or thick and rough. Cucumber plants naturally thrive in both temperate and tropical environments, and generally require temperatures between 60-90°F/15-33°C. With respect to economic importance, it ranks fourth after tomatoes, cabbage and onion in Asia (Eifediyi and Remison, 2010). The flesh of cucumber is rich in Vitamin A, Vitamin C, K and folic acid, while the hard skin is rich in fiber and a range of minerals including magnesium, molybdenum and potassium (Fiona *et al.,* 2015). Cucumber contains silica, a trace mineral that contributes greatly to strengthening our connective tissues (Schieberle *et al.,* 1990). The fruits are used for preparation of cosmetic items like soap and cream and in many other ways (Dhiman and Parkash, 2005). It is an ideal summer vegetable crop chiefly grown for its edible tender fruits, preferred as a salad ingredient, pickles and as a cooked vegetable (Shah *et al.,* 2016). It contains various phytochemicals like tannins, cardiac glycosides, terpenoides, carbohydrates, resins, saponins and phytosterols. While other phytochemical like alkaloids, flavonoids, glycosides, steroidal terpenes and phylobatamins were found to be absent in all the extracts (Sood *et al.,* 2012). The plant has large leaves that form a canopy over the fruit. The fruit of the cucumber is roughly cylindrical, elongated with tapered ends, and may be as large as 60 cm (24 inches) long and 10 cm (3.9 inches) in diameter. Having an enclosed seed and developing from flowers, botanically speaking, cucumber can be classified as an accessory fruit (Huang *et al.,* 2009). Cucumber has high alkaline levels, thus regulating the body blood pH and neutralizing acidity. People with gastric issues should consume cucumbers frequently. Since cucumbers contain mostly water, they

are excellent food to help cleanse and wash away toxins. Toxins are often stored in fat cells and cause inflammation. But beyond just water content, cucumbers also supply electrolytes to restore hydration of the body cells and balance the fluid levels in the body. This makes cucumber an important food to aid in weight loss and other inflammatory conditions such as arthritis (Renner *et al.,* 2007). Regular intake of cucumber fruit promotes healthy hair growth. It is useful in skin problems, sunburn and also for curing swelling under the eye. Its juice is also efficient to soften the skin texture. Placing the two slice of cucumber on eyes for 10 min can decrease the inflammation significantly. It is also beneficial for curing skin infection like eczema. In sun stroke, pieces of cucumber are placed on the head so that the patient may breathe moistened air in order to neutralize heat of his body. Fruit is also considered important for weight loss. Traditionally, seeds were used to expel the intestinal worms and tapeworms. The remedy is carried out when mashed seeds mixed with sugar that should be taken before any meal. Leaves are boiled and mixed with cumin seeds, roasted and powdered, are administrated in throat infections in the doses of 30 g or more (Shrivastava and Roy, 2013). Kashif *et al.* (2008) reported that due to elevated content of potassium (50-80 mg/100 g), cucumber could significantly be helpful for both high and low blood pressures. The fruit extracts of yellow cucumber possess more antioxidant activity. The activity may be due to the presence of carotenoids, phenolic flavonoids, tannins, polyphenols and lycopene, found in it. Raw cucumber (*Cucumis sativus*) fruit juice contains phytochemicals and phytonutrients of antioxidative bioactivities while overdose of amoxicillin could bring about drug-induced toxicity and oxidative stress. Malondialdehyde (MDA) is an oxidative index, while catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPx) are scavenging antioxidants (Mathew Folaranmi Olaniyan and Temitayo Afolabi, 2018). The extract of *C. sativa* has shown to possess significant carminative and antacid property. The extract of *C. sativa* has shown to possess significant property against ulcerative colitis (Patil *et al.,* 2012a). Extracts of *C. sativus* have good effectiveness on wound healing (Patil *et al.,* 2012b). Salicylic acid in copper induced physiological and biochemical changes and the possible induction of oxidative stress in detached cucumber cotyledons. Fresh weight accumulation and the photosynthetic pigment content were decreased and the levels of some important parameters regarding oxidative stress in the cotyledons, namely, lipid peroxidation (MDA), glutathione (GSH) and proline were increased (Çanakci-Gülengül *et al.,* 2017). Cucumber juice is commonly used for treating diseases of teeth and gums. Its juice is still useful for rheumatic conditions and healthy growing hair (Khulakpam *et al.,* 2015). There are traditional but non-scientific applications of cucumber to heal many skin problems, manage diabetes, control blood pressure, prevent constipation and kidney stones and sunburn. Cucumber also contains ascorbic and caffeic acids which prevent water loss, therefore, it is frequently applied topically to burns and dermatitis. Cucumber has excellent cleaning properties, and they actively remove accumulated waste and toxins from the body. Drinking cucumber juice can result in the development of strong and healthy bones and teeth due to its vitamin K content (Schieberle *et al.,* 1990). *C. sativus* extracts have their anti-oxidant, anti-microbial potential and their cosmetic value in treatment of acne (Himani Budhiraja *et al.,* 2014).

Several researches mentioned to processing of cucumber (*Cucumis sativus*). The study was carried out for the preparation of good quality mixed vegetable juice from tomato, cucumber and pumpkin. Three formulations of different percentages of juices of each vegetable were used for the preparation of mixed juice (Rowshon Habib and Abdullah Iqbal, 2014). Potential of high-pressure processing and high-temperature/short-time thermal processing on microbial, physico-chemical and sensory assurance of clear cucumber juice was investigated (Fengxia Liu *et al.,* 2016). The optimization of the fermentation process with reference to yeast concentration and the period of fermentation has been attempted by using Response Surface Methodology (Keerthika *et al.,* 2017). An attempt has been made in the present study for the development of a cucumber-based blended herbal beverage using sugarcane juice, citric acid, mint and coriander extract (30 : 30 : 30) along with salt (white salt : black salt 1 : 1) at varying concentrations using the response surface methodology (Heena *et al.,* 2017).

Influence of different types of sodium chloride (NaCl) on cucumber (*C. sativus* L.) preserved by lactic fermentation was investigated (Rózsa *et al.,* 2018).

Cucumber juice is a diuretic, so it is able to prevent kidney stones too. It can also counter the effects of uric acid, which prevents inflammation from conditions such as arthritis, asthma and gout (Shang *et al.,* 2014). Due to the numerous health benefits of cucumber, it is gaining tremendous importance in the food industry. In the present study, various technical parameters influencing the production of cucumber (*C. sativus* var. *conomon)* juice were clearly investigated such as ratio of flesh : water, sugar supplementation during the blending process; pasteurization, storage condition to stability of cucumber juice.

MATERIALS AND METHODS

Materials Used

We collected cucumber fruit (Fig. 1) in Hau Giang, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 8 h for experiments. Fruits were washed thoroughly under turbulent washing to remove dirt, dust and adhered unwanted material. Besides cucumber fruits we also used other materials during the research such as sugar, Petrifilm-3M. Lab utensils and equipments included pH meter, refractometer, viscometer, blender, thermometer, oven, refrigerator, incubator and colony counter. This research was conducted during 2017-18 in the Scientific Laboratory of Global Food Technology Ltd.

Fig. 1. Cucumber (*Cucumis sativus* var. *conomon*) fruit.

Water Supplementation (Flesh : Water) during the Blending Process

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water was added in different ratio (1.0 : 1.0 w/v, 1.0 : 1.5 w/v, 1.0 : 2.0 w/v, 1.0 : 2.5 w/v and 1.0 : 3.0 w/v) of (flesh/water) to facilitate the blending process. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of flesh : water.

Sugar Supplementation to Viscosity and Sensory Attributes of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water was added in 1.0 : 2.5 w/v. Different amount of sugar (4.0, 6.0, 8.0, 10.0 and 12.0%) was added to the cucumber juice. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of sugar supplementation.

Pasteurization for Viscosity, Sensory and Microbial Attributes of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water and sugar were added in 1.0 : 2.5 w/v and 10.0%, respectively. Cucumber juice was pasteurized in different condition (80°C, 75 sec; 85°C, 60 sec; 90°C, 45 sec; 95°C, 30 sec and 100°C, 15 sec). Viscosity, sensory and microbial measurements were applicated to demonstrate the optimal condition of pasteurization.

Storage Condition for Shelf Life of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water and sugar were added in 1.0 : 2.5 w/v and 10%, respectively. Cucumber juice was pasteurized in 95°C, 30 sec. Pasteurized cucumber juice was stored under refrigeration temperature (4°C) and ambient temperature

(28°C) for 12 weeks. Samples were analyzed for brix, titratable acidity (g citric acid/100 g), pH, aerobic mesophilic bacteria, mould/yeast and Enterobacteriaceae counts at regular intervals of six weeks.

Physico-chemical and Biological Analysis of Cucumber Juice

Cucumber juice was filtered on a cotton cloth and the volume (yield) of juice obtained from each sample was measured using a 500 ml volumetric flask. The moisture, crude protein (N x 6.25), crude fat and ash contents of cucumber flesh and cucumber juice were determined using relevant AOAC methods (AOAC, 1984). Titratable acidity (g citric acid/ 100 g) and pH of the samples were determined. Total soluble solids (TSS) were measured by refractometer. The viscosity measurement was made by using a viscometer. For sensory evaluation of the juices, the product was evaluated by a panel of 30 semi-trained panelists. Panelists were required to evaluate the odour, colour, taste, sweetness and overall acceptance using the 9-point hedonic scale (1 = dislike extremely, 9 = like extremely). 3M-Petrilm was used to analyze TPC, Enterobacteriaceae, *E. coli*.

Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTS AND DISCUSSION

Nutritional Composition of Cucumber Flesh and Cucumber Juice

Nutritional composition in cucumber flesh was primarily examined. Table 1 shows the physico-chemical composition of cucumber flesh and cucumber juice. According to Uzuazokaro Mark-Maria Agatemor *et al.* (2018), the phytochemical and proximate compositions of cucumber were investigated. Quantitative phytochemical analysis of the homogenate of *C. sativus* fruit showed that reducing sugar

Table 1. Nutritional composition of cucumber flesh

Parameter	Cucumber flesh*
Moisture (%)	83.19±0.02
Fat (%)	1.05±0.00
Protein (%)	3.45±0.01
Ash (%)	0.87±0.03
Carbohydrate (%)	0.92±0.02
Brix (°)	11.45±0.01
pH	6.42±0.00
Acidity (g citric acid/100 g)	1.16±0.03

*Values are expressed as the mean of three replications.

(574.36±3.88 mg/g) was highest amount when compared to other phytochemicals, alkaloids (2.22 ± 0.96 mg/g) and flavonoids (2.14±0.56 mg/g) were moderately present, while cyanogenic glycoside (0.21±0.13 mg/g) was the lowest in quantity. Proximate analysis showed that *C. sativus* fruit contained the following– fibre (1.02±0.01%), moisture (94.2±0.08%), protein (3.01±0.07%), lipid (0.55±0.13%), carbohydrate (0.28±0.09%) and ash (0.94± 0.24%) contents.

Effect of Water Supplementation (Flesh : Water) during the Mixing Process

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water was added in different ratio (1.0 : 1.0 w/v, 1.0 : 1.5 w/v, 1.0 : 2.0 w/v, 1.0 : 2.5w/v and 1.0 : 3.0 w/v) of (flesh/water) to facilitate the blending process. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of flesh : water. The optimal ratio of flesh : water should be 1.0 : 2.5 (Table 2). Peel and pulp of *C. sativus* L. fruit were extracted from aqueous (water) and phosphate buffered solution at incubated temperature of 37°C similar to normal human physiological temperature to investigate the potential of these extracts as antibacterial and cytotoxic agents (Fiona *et al.,* 2015).

Effect of Sugar Supplementation on Viscosity and Sensory Attributes of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water

Table 2. Effect of water supplementation (flesh : water) during the mixing process

Flesh : water (w/v)	1.0 : 1.0	1.0 : 1.5	1.0 : 2.0	1.0 : 2.5	1.0 : 3.0
Viscosity (cp)	1,136±0.07^{a}	1,104±0.13^{b}	1,024±0.26^{c}	994±0.14^{d}	945±0.09^{e}
Sensory score	2.75±0.00^{e}	3.79±0.01^{d}	5.49±0.00^{b}	7.41±0.02^{a}	4.63±0.02^{c}

Values are expressed as the mean of three replications.
Figures in a column followed by the same superscript are not significantly different at P=0.05.

was added in 1.0 : 2.5 w/v. Different amount of sugar (0, 4.0, 6.0, 8.0, 10.0 and 12.0%) was added to the cucumber juice. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of sugar supplementation. The optimal sugar supplementation should be 10% (Table 3). Optimization of the different variables for the development of a cucumber-based blended herbal beverage was examined. Cucumber juice can be successfully blended with sugarcane juice to enhance its sensory properties, as well as the phytochemical potential (Heena *et al.,* 2017).

Effect of Pasteurization on Viscosity, Sensory and Microbial Attributes of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water and sugar were added in 1.0 : 2.5 w/v and 10.0%, respectively. Cucumber juice was pasteurized in different conditions (80°C, 75 sec; 85°C, 60 sec; 90°C, 45 sec; 95°C, 30 sec and 100°C, 15 sec). Viscosity, sensory and microbial measurements were applicated to demonstrate the optimal condition of pasteurization. The optimal condition in pasteurization should be 95°C, 30 sec (Table 4).

Clear cucumber juice, clarified by ultra-filtration (UF), was treated by high-pressure processing (HPP, 500 MPa/5 min) and high-temperature/short-time thermal processing (HTST, 110°C/8.6 s), and stored at 4°C. UF significantly decreased total aerobic bacteria (TAB) and yeasts and molds (Y&M) in the juice by 1.35±0.11 and 1.94±0.02 log cycles, respectively, increased juice clarity to 99.85±0.07%, and did not change pH, titratable acidity (TA) and four key aroma compounds of (Z)-6-nonenal, (E, Z)-2,6-nonadienal, (E)-2-nonenal, and (E, Z)-3,6-nonadien-1-ol. Following the UF, TAB and Y&M in the juice were reduced by HPP or HTST to be < 1 log cycle, and showed no outgrowth after refrigerated storage of 20 days. HPP-treated juice showed less total colour change, higher clarity and retained more key aroma compounds than HTST-treated juice. Moreover, sensory evaluation suggested that HPP-treated juice always showed higher scores for overall acceptability than HTST-treated juice. The combination of HPP and refrigeration could be used as an alternative to produce high quality clear cucumber juice with a shelf-life of 20 days (Fengxia Liu *et al.,* 2016).

Table 3. Effect of sugar supplementation

Sugar supplementation	0%	4.00%	6.00%	8.00%	10.00%	12.00%
Viscosity (cp)	994±0.14^{f}	1,014±0.17^{e}	1,083±0.12^{d}	1,143±0.21^{c}	1,184±0.15^{b}	1,213±0.13^{a}
Sensory score	7.41±0.01^{c}	7.69±0.00^{bc}	7.92±0.02^{b}	8.02±0.03^{ab}	8.15±0.00^{a}	8.06±0.02^{ab}

Values are expressed as the mean of three replications.
Figures in a column followed by the same superscript are not significantly different at P=0.05.

Table 4. Effect of pasteurization on viscosity, sensory and microbial attributes of cucumber juice

Pasteurization	80°C, 75 s	85°C, 60 s	90°C, 45 s	95°C, 30 s	100°C, 15 s
Viscosity (cp)	1,263±0.17^{a}	1,247±0.21^{ab}	1,231±0.14^{b}	1,219±0.09^{bc}	1,184±0.15^{c}
Sensory score	7.13±0.02^{c}	7.89±0.03^{bc}	8.04±0.00^{b}	8.33±0.02^{a}	8.15±0.00^{ab}
Enterobacteriaceae (cfu/g)	0	0	0	0	0

Values are expressed as the mean of three replications.
Figures in a column followed by the same superscript are not significantly different at P=0.05.

Table 5. Effect of storage condition on stability of cucumber juice

Parameters	Storage temperature (4°C), week			Storage temperature (28°C), week		
	0	6th	12th	0	6th	12th
Total soluble solid (°Brix)	16.79±0.03^{a}	16.65±0.00^{ab}	16.4±0.01^{b}	16.79±0.03^{a}	16.33±0.03^{ab}	16.26±0.02^{b}
Titratable acidity (g citric acid/100 g)	1.22±0.00^{a}	1.14±0.02^{ab}	1.06±0.03^{b}	1.22±0.00^{a}	1.11±0.02^{ab}	1.04±0.03^{b}
pH	5.75±0.02^{b}	5.82±0.01^{ab}	5.85±0.02^{a}	5.75±0.02^{b}	5.93±0.01^{ab}	5.97±0.02^{a}
TPC (cfu/g)	5.9x10^{1}±0.03^{b}	6.5x10^{1}±0.02^{ab}	7.3x10^{1}±0.01^{a}	5.9x10^{1} ±0.03^{b}	7.2x10^{1}±0.00^{ab}	8.5x10^{1} ±0.03^{a}
Mold (cfu/g)	0	0	0	0	0	0
Enterobacteriaceae (cfu/g)	0	0	0	0	0	0

Values are expressed as the mean of three replications.
Figures in a column followed by the same superscript are not significantly different at P=0.05.

Effect of Storage Condition to Shelf Life of Cucumber Juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the flesh blended using an electric blender. The flesh was filtered using a muslin cloth. Water and sugar were added in 1.0 : 2.5 w/v and 10.0%, respectively. Cucumber juice was pasteurized in 95°C, 30 sec. Pasteurized cucumber juice was stored under refrigeration temperature (4°C) and ambient temperature (28°C) for 12 weeks. Samples were analyzed for total soluble solid (°Brix), titratable acidity (g citric acid/100 g), pH, aerobic mesophilic bacteria, mould/yeast and Enterobacteriaceae counts at regular intervals of six weeks. From Table 5, the cucumber juice had a stable quality in ambient temperature during preservation.

An experiment compared the effect of different chemical additives, namely, sodium benzoate, potassium metabisulfite (KMS) and their combination, on the physico-chemical and phytochemical parameters and antioxidant activity of cucumber juice. The storage was done for six months at room temperature and the analysis was conducted at the interval of one month. For the physico-chemical parameters like TS, TSS, acidity, colour values (Lab), a very slight but non-significant change was observed. Vitamin C, total phenols and antioxidant activity changed significantly (P≤0.05). The variation was found in the colour of different samples. Considering all the parameters, samples treated with potassium metabisulfite maintained the maximum nutrient stability (Gurpreet Kaur *et al.,* 2014).

CONCLUSION

Cucumber (*C. sativus* L.) is extremely beneficial to health especially during the summer as it mostly contains water and many important nutrients that are essential for human body. Cucumber is consumed in different ways like sweet vegetable and salads. Cucumber (*C. sativus*) belongs to Curcurbaticeae family possessing anti-bacterial, anti-microbial, anti-funal characteristics and showed activities like antioxidant, phytochemical and hypoglycaemic activity. It is also used as traditional remedies. *C. sativus* contains some essential vitamins and anti-oxidants which are effective in human health. Therefore, the objective of this study was to determine the storage stability of cucumber juice. We have successfully optimized various technical parameters influencing the production of cucumber (*C. sativus* var. *conomon)* juice which were clearly investigated such as ratio of flesh : water, sugar supplementation during the blending process; pasteurization, and storage condition to stability of cucumber juice. People drink cucumber juice on warm days to help cool their body. Cucumber juice in the diet is one of the best favourable juices to improve and maintain healthy skin, nails and hair, weight loss, high blood pressure, acne and eczema to dissolve kidney stone.

REFERENCES

Çanakci-Gülengül, S., Yildiz, T. and Deveci, D. (2017). Some physiological and biochemical responses to copper of detached cucumber (*Cucumis sativus* L.) cotyledons pre-floated in salicylic acid. *Pak. J. Bot.* **49** : 487-92.

Dhiman and Prakash, C. (2005). Correlation and path coefficient analysis in cucumber. *Haryana J. Hortic. Sci.* **34** : 111-12.

Eifediyi, E. K. and Remison, S. U. (2010). Growth and yield of cucumber (*Cucumis sativum* L.) as influenced by farm yard manure and

inorganic fertilizer. *J. Plant Breed. and Crop Sci.* **2** : 216-20.

Fengxia Liu, Xiaoxi Zhang, Liang Zhao, Yongtao Wang and Xiaojun Liao (2016). Potential of high-pressure processing and high-temperature/short-time thermal processing on microbial, physico-chemical and sensory assurance of clear cucumber juice. *Innovative Food Sci. and Emerging Technologies* **34** : 51-58.

Fiona, H. N., Aqeelah, M. and Solachuddin, J. A. (2015). Biological properties of cucumber (*Cucumis sativus*) extracts. *Malaysian J. Analytical Sci.* **19** : 1218-22.

Gurpreet Kaur, Aggarwal, Poonam and Javed, Mohammed (2014). Effect of chemical additives on the shelf life of cucumber juice. *J. Engg. Res. and Applic.* **4** : 206-09.

Heena, V. K., Jaspreet Kaur, Gat, Yogesh, Chandel, Ashwani, Suri, Sheenam and Panghal, Anil (2017). Optimization of the different variables for the development of a cucumber-based blended herbal beverage. *Beverages* **3** : 1-13.

Himani Budhiraja, Rajinder K. G. and Pratibha Nand (2014). Formulation and characterization of *Cucumis sativus* extract in the treatment of acne. *World J. Pharmacy and Pharmaceut. Sci.* **3** : 1043-57.

Hina Saeed and Anam Waheed (2018). A review on cucumber (*Cucumis sativus*). *Int. J. Tech. Res. & Sci.* **2** : 402-05.

Huang, S., Li, R., Zhang, Z., Li, L. and Gu, X. (2009). The genome of the cucumber (*Cucumis sativus* L.). *Nature Genet.* **41** : 1275-81.

Kashif, W., Kamran, Q. M. and Jilani, M. S. (2008). Effect of different nitrogen levels on growth and yield of cucumber (*Cucumis sativus* L.). *J. Agric. Res.* **46** : 259-66.

Keerthika, T., Devaki, C. S., Florence Suma, P. and Asna Urooj (2017). Development of cucumber fermented beverage using response surface methodology. *Intl. J. Food Ferment. Technol.* **7** : 181-90.

Khulakpam, N. S., Singh, V. and Rana, D. K. (2015). Medicinal importance of cucurbitaceous crops. *Int. Res. J. Bio. Sci.* **4** : 1-3.

Patil., K., Kandhare, A. and Bhise, D. (2012a). Effect of aqueous extract of *Cucumis sativus* Linn. fruit in ulcerative colitis in laboratory animals. *Asian Pacific J. Trop. Biomedicine* **1** : 962-69.

Patil, K., Kandhare, A. and Bhise, D. (2012b). Pharmacological evaluation of ameliorative effect of aqueous extracts of *Cucumis sativus* L. fruit formation on wound healing in Wister rats. *Chronicles of Young Scientists* **2** : 207-13.

Renner, S. S., Schaefer, H. and Kocyan, A. (2007). Phylogenetics of cucumis (Cucurbitaceae) : Cucumber (*C. sativus*) belongs in an Asian/ Australian clade far from melon (*C. melo*). *BMC Evol. Biol.* **7** : 58.

Rowshon Habib and Abdullah Iqbal (2014). Processing of mixed vegetable juice from tomato, cucumber and pumpkin. *Food Sci. and Technol.* **2** : 83-91.

Rózsa, S., Lazar, V., Moniutiu, D. N., Gocan Tincuta-Marta, Rózsa Melinda and Posta, G. (2018). Influence of different types of sodium chloride (NaCl) on cucumber (*Cucumis sativus* L.) preserved by lactic fermentation. *J. Hortic. Forestry and Biotechnol.* **22** : 93-98.

Schieberle, P., Ofner, S. and Grosch, W. (1990). Evaluation of potent odorants in cucumber (*Cucumis sativus*) and muskmelon (*Cucumis melo*) by aroma extract dilution analysis. *J. Food Sci.* **55** : 193.

Shah, K. N., Rana, D. K. and Singh, V. (2016). Evaluation of different cucumber strains for various horticultural traits under valley condition of Garhwal Himalaya. *J. Plant Dev. Sci.* **8** : 599-603.

Shang, Y., Ma, Y., Zhou, Y., Zhang, H., Duan, L. and Chen, H. (2014). Plant sciences-Biosynthesis, regulation and domestication of bitterness in cucumber. *Science* **346** : 1084-88.

Shrivastava, A. and Roy, S. (2013). Cucurbitaceae : A ethnomedicinally important vegetable family. *J. Med. Plant Studies* **1** : 16-20.

Sood, A., Kaur, P. and Gupta, R. (2012). Phytochemical screening and antimicrobial assay of various seeds extract of Cucurbitaceae family. *Int. J. Appl. Biol. and Pharmaceut. Technol.* **3** : 401-09.

Uzuazokaro Mark-Maria Agatemor, Okwesili Fred Chiletugo Nwodo and Chioma Assumpta Anosike (2018). Phytochemical and proximate composition of cucumber (*Cucumis sativus*) fruit from Nsukka, Nigeria. *African J. Biotechnol.* **17** : 1215-19.