A Study on Syrup of *Juniperus excelsa*Cones Grown in Türkiye

ABSTRACT

For bewerage products, some anayltical tests are conducted prior to packaging and distribution. However, physicochemical properties may affect product quality adversely in a number of ways. Liquids with high dissolved solids may impact inferior palatability and may induce an unfavorable physiological reaction in the transient consumer. In this study, it was evaluate some certain physicochemical properties of syrup which made from *Juniperus excelsa's* berries whichwere collected four different geographical location of stands which are managed Regional Directorate of Forestry authories.A considerable physicochemical variations found among *Juniperus excelsa's*berry-based syrup products. The lowest value of pH: 5.46 was found with syrup prepared from Yalvaç-Isparta, (sample C), followed by pH: 5.75 from Hisarcık-Kütahya, (sample D), pH: 5.80 Ağlasun-Burdur (sample B), and pH: 6.32 Gazipaşa-Antalya (sample A), respectively. However, syrup prepared from sample C showthe highest values of EC, TDS and Brix, and also distinguished from the others by the highest ORP value. It was found to be 3136.1 uS/cm for EC, 1568 ppm for TDS, 1.90 °Bx for Brix and 188.6 mV for ORP of sample C. However, the highest turbidity value of 67.6 NTU was found with sample D while the lowest with sample A (39 NTU). These values may be a good criterion for the botanical origin of syrup and therefore it may be used in syrups prepared from *Juniperus excelsa's* berries.

Keywords:*Juniperus excelsa* berry*,* syrup, pH, EC, TDS, turbidity

INTRODUCTION

Juniperus excelsa is a flowering plant belonging to *Cupressaceae* family which consisting of more than 60 species **[1,2].** However, except *Juniperus procera* which is reported to be only species of the genus that grows naturally in the southern hemisphere, rest of are naturally grown throughout the northern hemisphere of the world **[2].**It has reported that it could be reaches up to 20 meter height with a trunk as large as 2.0 meter in diameter while an evergreen shrub with a conical habit **[1,3].**

Juniperus excelsa is generally described as very durable landscape plants which growth habits vary from low growing to upright or spreading shrub to small tree. Due to it tolerates maritime exposure's and planted in wide range of soil pH's, the landscape architect may find this tree useful as a compact evergreen conifer**[4]**whilealso very attractive to some birds and creatures**.** However, those can also be found wide range of shapes and sizes while needle color varies from blue to dark green**[1-4].** In this regard, they can offer many uses in the landscape from ground covers to specimen trees. Some of the common utulizaition of juniperus species for landscape applications are; screens, windbreaks, foundation plants, specimen plants, shrubs borders and other diverse landscape designs. Moreover, junipershave also suggested to be useful in landscapes in urban settings due to high tolerance to heat, and poor, dry soils**[5-7].** Due to wide variations in physical apperances, they should be given preference in landscape plantings which used as hedges or for other formal appearance.

However, the chemical constituents of a given plant areusually believed to be genetically determined and considerably influencedby environment. These chamicals may be an economic value, along with in plant defense system against fungus and insect attacks **[4,5].**The chemicalcompounds of junipershave also been reported to change due to interspecific differences **[2, 4,5].**Numerous literature reports suggest that there are many variable effects on extractive content of plant species including cones, flowers, wood or leaf of even in same species. Beside age, maturity, geographic locations, irrigations and seasonal factors are reported to be very effective on chemical composition of parts of plant **[4-9].**

Juniperus species are characterized by high amount of essential oil in not only cone and needles, but also wood and seed. However a number of researchers has already reported that essential oil of J*. Excelsa'* berries are characterized by presence of very high amounts of α-pinene, followed by cedrol, L-verbenol and D-verbenol, limonene as predominat components **[1, 3-5, 9-14] .**There are many utilization methods from Juniper tree parts *(i.*e.cone, woods or leafs). Particularly, it's wood is one of the well known and desired source for pencil manufacturing. A number of literature findings reported that juniper berry oil is commonly used by local people as folk medicine, and believed to be an antiseptic, analgesic and sedative and has been useful to cure tuberculosis, jaundice, and eczema, bronchitis, as well as for so many other healings **[1,2, 5,7-14].** Along with these special chemical constituents and healing effects, in2000, the first officially Juninerus berryharvested with quantity of 16.830 kg, was made by Isparta Regional Directorateof Forestry, then it has become importnat non-wood sources for Regional Directorates of Forestry **[15].**

The evaluations and understanding environmental interactions on plant extractives are complex phenomenon and involve in many variables. These make effective utulization of chemicals into valuable products are challenging topic. The vast literature reports have already presented on various Juniper species that certain chemicals from different parts have found to be healing effects on many human disorders **(7-15).** But the majority of these studies are usually focused on chemical analysis quantively. To our knowledge, the literature data about comprehensive comparison of various characteristics of Juniperus syrup products are missing. However, no work has been found to investigate Juniper'sberriessyrup properties which commonly prepared and marketed as folk medicine by local entrepreneurs in Turkiye. The aim of this study was to comparatively investigate general properties of syrup which made from juniperus berrysamples were collected four different locations, namely Regional Directorate of Forestry stands of Antalya, Burdur, Isparta and Kütahyain Türkiye. Selected properties, such as; pH, electrical conductivity (EC), total dissolve solids (TDS), oxidation-reduction potential (ORP), refraction index (Brix value), and cloudness-haziness (Turbidity) were measured.

MATERIALS AND METHODS

The berries (cones) were collected from the Juniper stands of **Gazipaşa-Antalyaat 1683 m (sample A), Ağlasun-Burdurat 1360 m (sample B), Yalvaç-Ispartaat 1584 m (Sample C), and Hisarcık- Kütahyaat 1020 m (sample D)l**ocations where managed by Regional Directorate of Forestry authorities. Berry samples were collected from healthy mature trees having bluish-black ripeberries**in spring May 2022.** Trees were randomly selected ineach location and approximately 100 representative samples were collected from all sides of the crown.

The*Juniperus excelsa*berries initially green, ripening to blue/ black in colour. **Figure 1** show the general charectiristics of geopraphic regions where berries were suppliedand geological map for collecting samples. The collected berries were manually cleaned from solid contaminants, then carefully washed with distilled water to remove dust and muds. The clean berries were stored in standard containersat 4^{0}C untill analyzed. The experimental procedures were conducted in botanic laboratory of Forest engineering department, Faculty of Forestry, Isparta University of Applied Sciences-Türkiye.

In syrup preparing procedure, 1.0 kg of contaminant free and washed/cleanedberries were put in container and crushed until oil/liquid mixture presented. Then pressed berries were mixed in 20 lt water and wait 30 minutes. After it was cooked at constant heat. When this aqueus mixture have become boiled, 5 lt water was added which was repeated two times. Total of 30 lt water and 1.0 kg crushed/pressed berries were used with 4.0 hours of cooking time. At the end, the syrup paste was screened and sperated as solid and liquid. However, solid free screened liquid is further cooked for 2.0 hours. When mixture have become reddish/brownish color, the syrup preparing procedure ended and the syrup poured to containers.

The general properties of *Juniperus excelsas's* syrup was investigated. While very complex chemical constituents, it is not intend to chracterize and determine all chemical constituents instead only basic apperance and cloudness/haziness (turbidty) parameters measured. Thereby, four parameters, commonly accepted for determining liquid quality level, have been selected. These were; pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), and Oxidation Reduction Potential (ORP) were examined. A multi-parameter instrument (Jinan Huiquan Electronic Co., Ltd, China)was used to measure these values. The cloudiness or haziness of syrup samples were determined by a turbidity meter (Hanna HI 93703, East Drive Woonsocket, RI, USA) according to the ISO 7027 International Standard.

A Palm Abbe model PA2021 digital refractometer (Solon, OH) was used for all experiments using syrup's Brix (°Bx) level. While the device supports automatic temperature compensation, all studies were conducted with the instrument and materials at ambient temperature.

An analysis of variance (ANOVA) was used for the statistical determination of physicochemical variations. All multiple comparisons were individually evaluated and significant differences among the average pH, EC, TDS, ORP, Turbidityand Brix values were determined. Duncan test was used to make comparison among board types for each property tested if the ANOVA found significant.

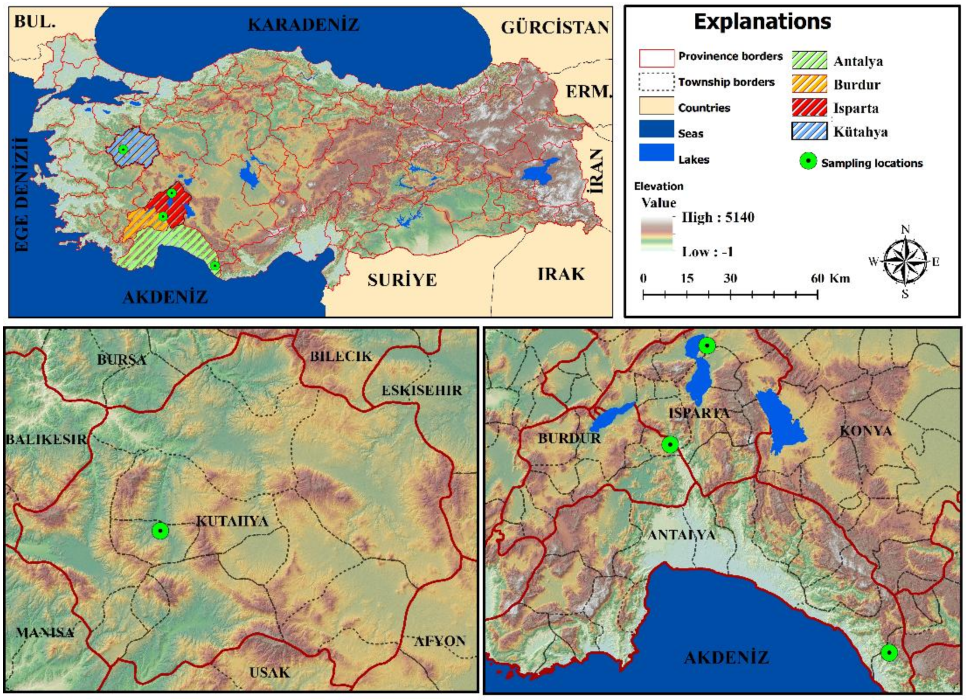

Figure 1. Geological map of juniperus excelca berries supplied from

RESULTS AND DISCUSSIONS

The foods are variates in tasteand also variates beauty in presentation, color, can be served with beautiful appearance. There is no any coloring ingredients used during syrup preperation from *Juniperus excelsa's* berries while syrups appear to a reddish-brown color at ambient codition, as shown in **Figure 2.**However, geographical sampling of berries effects variation on appearance of color particularly intensity.Besides measuring the quality of water which is used to indicate the presence of pathogens, bacteria, and other contaminants, it was suggested to measure colour intensity or cloudness-haziness of a food products with using turbidity method**(16-19).**Depending on the application, it is a colour-compensated angle scattered light measurement for ensuring the quality of the product. It is also used for dairies and bewerage industries for predicting quality assurance, cost and process optimisation**(16-17).**In our study, the highest turbidity value of 67.6 NTU was found with **D**, followed by 55.9 NTU **(C),** 46.3 NTU (**B**), 39.0 NTU **(A),** respectively. It has well proposed that the higher the turbidity, the greater the amount of scattered light.Although visual apperance of a beverage is one of the most important acceptance criteria for consumers, while the preared syrups may or may not look aesthetically pleasing, but there is no clear evidence that the safety of the bewerage has been compromised **(16-19).**

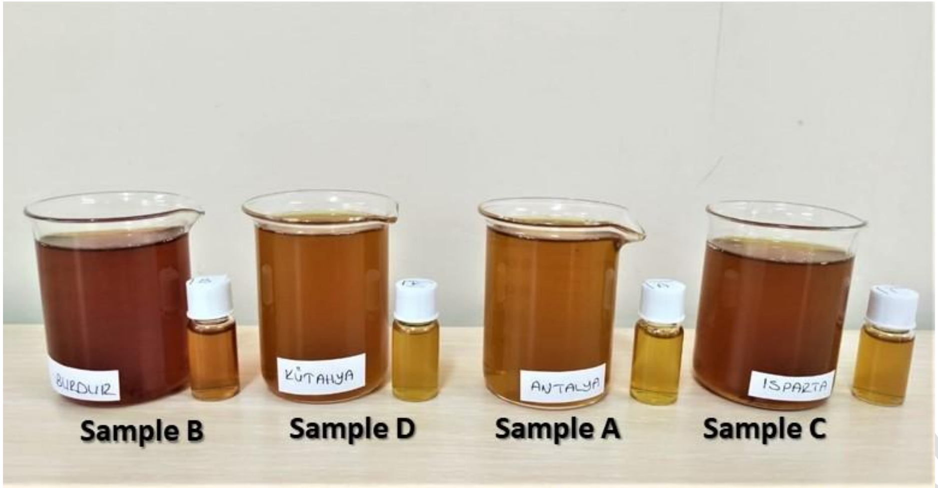

Figure 2. The general apperance of syrups prepared from Juniperus excelsa's berries.

The parameters of pH, EC, TDS, ORP have already reported to be useful methods for determining certain chracteristics of foods **(20-25).**These parameters were recently included in the international standards replacing the determination of ash content for honey **(22).**In thes regards,the selected average physicochemical results are presented in **Table 1,** comparatively. In four syrup samples, the highestvalue of EC, TDS, ORP and Brix were found to be in **sample C** with lowest pH value. These measured results may be used to distinguish between geographic sampling locations of *Juniperus excelsa's*berries.

The pH and/or acidity of a food are generally used to determine processing requirements and the applicability of *Good Manufacturing Process* (GMP) regulations which require a quality approach to manufacturing, enabling companies to minimize or eliminate instances of contamination, mixups, and errors **(24).** However, methods and conditions for determining the pH and acidity of foods are also summarized in 21 CFR (Code of Federal Regulations) 114.90 in USA **(25).** A considerable pH variation exists between syrup varieties, which are the lowest pH value of 5.46 was found with **C**, followed by **D** (pH: 5.75), **A** (pH: 5.80) and **B** (pH: 6.32), respectively. According to USDA regulations **(24-25),** all pH values are found to be in acceptable level in edible of foods in their normal and natural state.

Electrical conductivity (EC) is a physicochemical measurement of the dissolved material in an aqueous (nutrient) solution, which relates to the ability of the material to conduct electrical current through it**(21-22)**. The EC values of syrup samples tested in our study are also listed in **Table 1.** The EC of **C** is rather high (3136.1 uS/cm), means that it contains higher amount of minerals. It appears to no relationship between sampling elevations and syrup types. It was measured 1042 uS/cm for **D**, 1058 uS/cm for **A**, 1235 uS/cm for **B**, in that order. The EC may be a good criterion for the botanical origin of syrup and therefore it may be used in routine syrup control.

Table 1. The general chracteristics of syrups.

Samples	**pH**	**EC (uS/cm)**	**TDS (ppm)**	**ORP (mV)**	**°Brix**
A	5.80[a] (0.09)	1058.8 [a] (13.1)	532.0 [a] (10.7)	160.6 [a] (6.9)	0.40 [a] (0.16)
B	6.32 [b] (0.04)	1235.8 [b] (40.7)	618.6 [b] (21.7)	155.8 [a] (5.4)	0.60 [b] (0.11)

C	5.49 ^{c} (0.04)	3136.1^{c} (8.9)	1568 ^{c} (8.4)	188.6 ^{b} (3.6)	1.90 ^{c} (0.22)
D	5.75 ^{a} (0.11)	1042.2 ^{a} (33.4)	522.0 ^{a} (16.8)	154.0 ^{a} (13.5)	0.50 ^{ab} (0.16)

Total solid determination, either dissolved or retained in foods is one of the most often used tests in quality control. As mentioned above, a number of chemical constituents are reported by numerous scientists, that Juniperus berries have components of essential oils, flavonoids, and many other extractives**[5-14].**The TDS of the syrups was found to be ranged from **522.0 ppm** (D) to **1568 ppm** (C). Statistically (with 95% confidence), there are no significant differences of TDSbetween samples of A and D while significant diferencens between samples B and C**(Table 1).**

Oxidation reduction potential (ORP)is a numerical index, measured in millivolts (mV) and can either be above zero (oxidizing conditions-lose electrons) or below zero (reducing conditions-gain electrons), which typically measured to determine the oxidizing or reducing potential of a water sample**(26).**The measurements exposed that sample C not only showed the highest values of EC, TDS and Brix of syrups, but also distinguished from the other samples by the highest ORP value as well. The highest ORP value of 188.6 mV was found for sample C, followed by 160.6 mV (sample A), 155.8 mV (sample B) and 154 mV (sample D), in that order.Statistically (with 95% confidence), there are no significant differences of ORP between samples of A, B and D while significant diferencens between samples C **(Table 1).**But it is important to note that all syrup samples show lower ORP values than drinkable water quality level while ORP level for clean and/or drinkable waters, should be lower than 500 mV **(27)**.

The Degrees Brix (°Bx) is traditionally used in various food industry (i.e., alcohol, soft drink, fruit juice and honey, so on.). Because many of consumers use to assess food or bewerage quality of flavor or sweetnes, it is a subjective important criterion. It has already well documented that there is a direct correlation between a food's Brix value and its taste, quality, potential sugar content, and nutritional density**(28-30).In our study, i**twas observed that **samples A, B and C** show very small variations for Brix value (A: 0.40-, B: 0.50- and C: 0.60 °Bx) while sample C had the highest value (1.90 °Bx) among four samples, though still statistically-significant difference in comparison with all samples (p <0.05). One may concluded that syrups prepared from *J. Excelsa* berries sensitive to sampling regions**(Table 1).**

However the turbidity values of samples found to be lowest for sample A (39 NTU), followed by sample B (46.3 NTU), sample C (55.9 NTU) and sample D (67.6 NTU), in that order.

In order to eveluate pHleveleffects on physicochemical properties of *Juniperus excelca's* berry syrups, the measured values were plotted against pH values. **(Figure 3).** It appears to pHof samples hasnot closely correlated with other measured values of; EC **(Fig.3A),** TDS **(Fig. 3B),** ORP (**Fig. 3C)**turbidity **(Fig. 3D)** and Brix **(Fig.3E).**

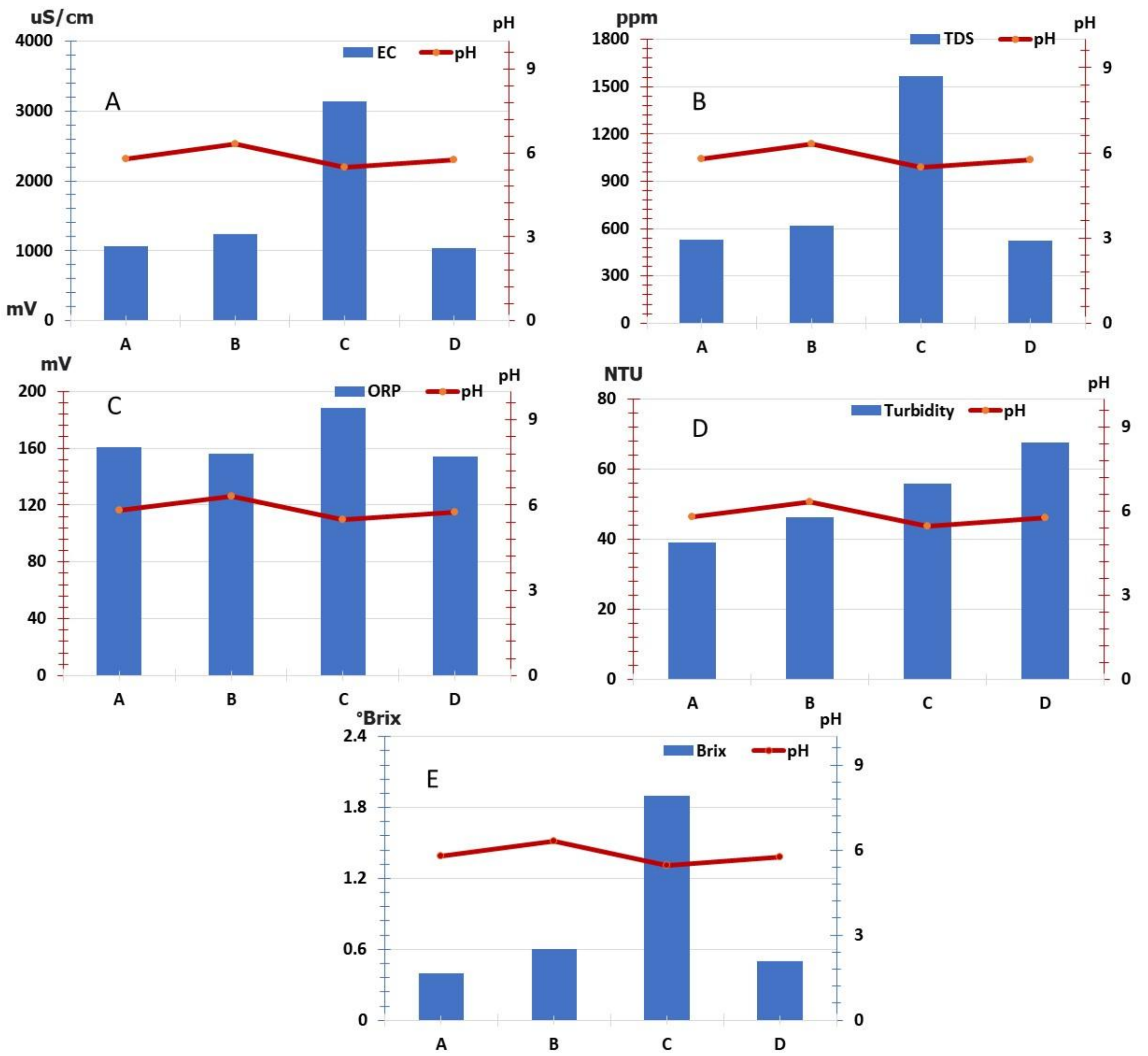

Figure 3. The effects of pH on physicochemical properties of syrups.

When Figure 3 carefully evaluated, other properties appear to correlated each other rather than pH. In this case, for evaluating sampling elevations impact on measured properties, the pH, EC, TDS, ORP, Turbidity and Brix values were plotted against sample collecting elevations **(Figure 4).**It appears to sample collecting elevations inversely related with pH (Fig. 4A) while EC **(Fig.4B),** TDS **(Fig. 4B) and** ORP (**Fig. 4D)**values have somehow related but no any correlation with turbidity **(Fig. 4E)** and Brix **(Fig 4F).**

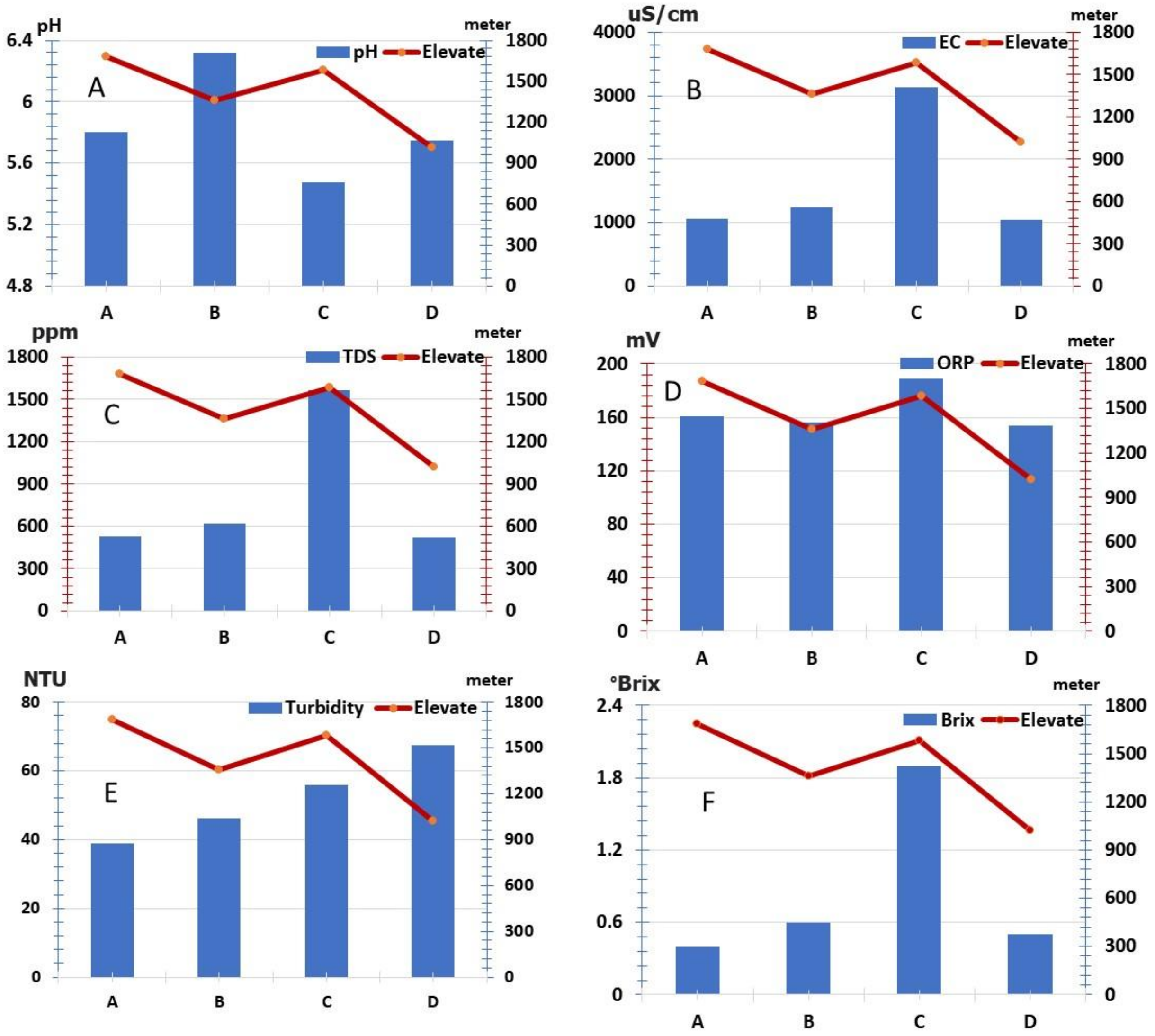

Figure 4. The effects of sampling elevations on physicochemical properties of syrups.

The findings in Table 1 and Figures 3 and 4 also suggest that different mechanism may control the increased or decreased measured properties. In this case, further invesitgation which is combine effects ofsample collecting elevation and pH were plotted against on EC **(Fig. 5A),** on TDS **(Fig. 5B),** on ORP **(Fig. 5C)** and on Turbidity **(Fig. 5D),** respectively**.** The dependence of EC, TDS and ORP (Fig. 5A-C) to sampling geographic locations (elevations) and pH show that those physicohemical properties has a somehow similar trend which show only narrow range of changes at initially (at 1020 m; sample D), then but very sharp decreasing (at 1360 m; sample B), then again marginally changes for sample A (at 1584 m) and C (at 1683 m). However, considerably different tren was observed with turbity that it is usually decreasing as sample collection elevation and pH values increased **(Fig. 5D).** The plot shapes in Figure 5 clearly suggest that all sample collection locations apparentlybring an effect of change these values. Hence the differentgeographic locations should control either increase or decrease in physicochemical properties of*syrups from J. Excelsa'* berries. This coluld be expected considering vast literature information have been reported on geographical conditions effects on chemical and botanical properties of plants while similar literature findings on juniperus species. Thereby, it is reasonable to suggest that theripening time of *J. Excelsa'* berries could be considered for producing more homegenous products from this species.

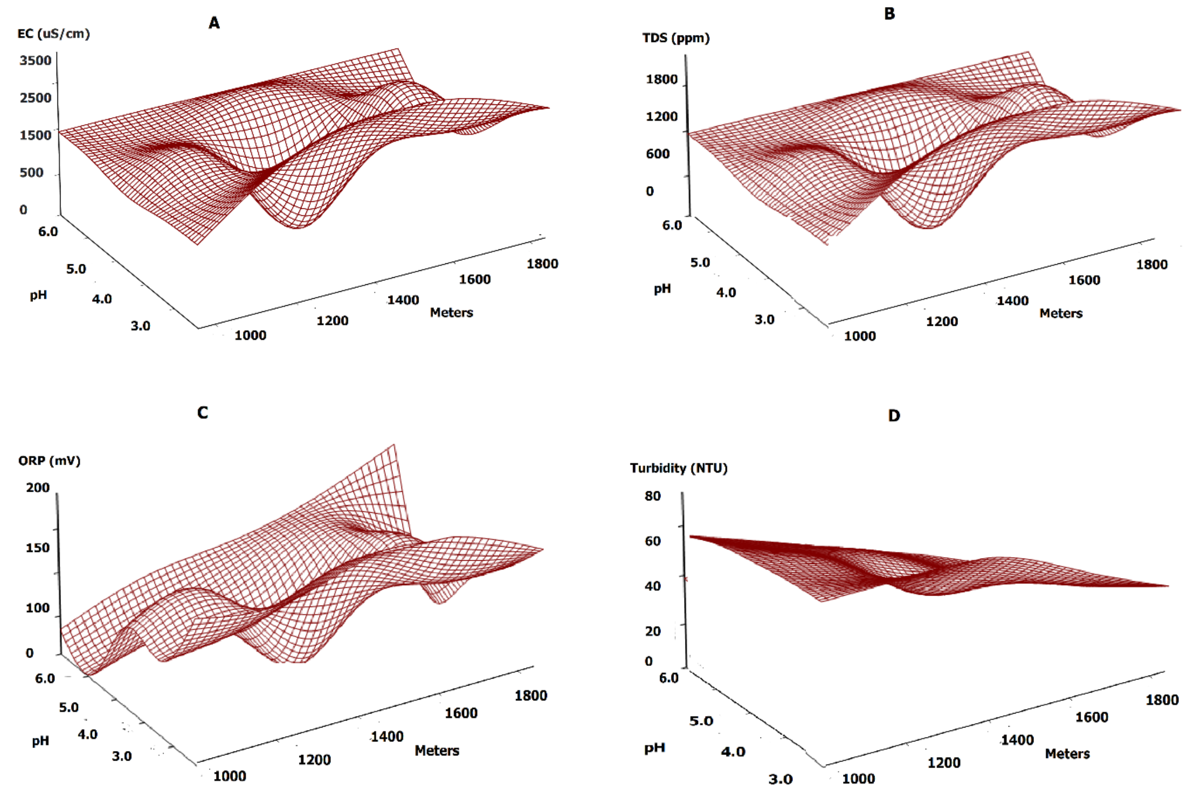

Figure 5. Combine effects of pH and sampling elevations on physicochemical properties of syrups

CONCLUSIONS

Some of the plants have becomeimportant source for alternative medicine, with cost effective ways of various healings.However, many herbaceous and woody plants have used in combination with other elements to make folk remedies. Although different parts of plants (i.e., leaves, cones, fruits, flowers) have gained increasing attentions and are widely utilized, but there are still some concerns particularly due to the growing locations effects on properties. Thereby a special attention should be taken on the use of medicine from plants. The experimental results found in this study clearly suggest a syrup product prepared from same plant species but from different geographical locations could be show different physicochemical properties. But in detail, many phenomenological properties were reported for plant substrates and the quantification of all those are very complicated and need further investigations.

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