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TURKISH TOBACCOS

Characteristics and Chemical Composition of Imported Types

F. R. DARKIS, E. J. HACKNEY, AND P. M. GROSS
Duke University, Durham, N. C.

The chemical analyses of twenty-four constituents or groups of constituents of imported oriental tobaccos are presented. The analyses are for tobaccos of varying grades from eighteen areas scattered over four of the main growing regions of Greece and Turkey; the tobaccos were grown in 1937 and 1938. These analyses show significant differences in chemical composition among the tobaccos from the four regions and among grades. They also show some differences among tobaccos from neighboring areas within the regions. These differences indicate a basis for the commercial practice of dividing oriental tobaccos into types and divisions of types along geographical lines, and in turn reassembling these to obtain a blend of more constant composition. A discussion of chemical analyses as they appear to be related to the commercial usages and evaluation of these tobaccos is presented. Also the chemical analyses are correlated, to the extent possible, with the existing climatic and soil conditions and the cultural practices in vogue in each geographical region.

DURING recent years, except for a period during the war, over 50 million pounds of tobaccos of the Turkish type were imported into the United States annually (25). These tobaccos are normally grown in Turkey, Greece, Bulgaria, and southern Russia. Except for some regions in Bulgaria, they are grown in areas relatively close to the shores of the Black, Aegean, and Mediterranean Seas. These tobaccos differ primarily from domestic tobaccos in that their leaf size is small and the intensity of their aroma is greater.

A large proportion of these tobaccos is imported to be incorporated in blends of popular brands of blended cigarets to improve their burning quality and aroma. These tobaccos cost the American manufacturer more than the average domestic tobaccos. Part of this increased cost is the import duty.

In view of the importance of this crop to the cigaret industry as a whole, and because of the significance that a more detailed knowledge of these tobaccos might hold for the American tobacco farmers, a program of research was initiated in 1939 at Duke University to study these tobaccos. This included an investigation of the possibility of producing a type of tobacco in the United States with properties similar to those of imported Turkish tobaccos. It also included a study of the chemical composition of imported types and of domestically grown aromatic tobaccos to permit comparisons between the two types and to increase our knowledge of each. To do this numerous samples of tobacco which were grown in Turkey and Greece in 1937 and 1938 were obtained from the importers and analyzed. The absence of chemical data in the literature for Turkish tobaccos imported into this country, and the significance of these data for a large and important industry, indicate the desirability of publishing this information.

These tobaccos are grown in areas surrounding villages and towns in which the people live who produce them. The tobaccos are usually named after one of the main towns in the area. They may also be known by the name of the seaport from which they are shipped or the city in which they are prepared for shipment.

Thus, the tobaccos grown in the numerous villages near Serres, Greece, are known as Serres tobacco, and those grown in the villages in the general area of Drama, Greece, are known as Drama tobacco. These tobaccos, as well as others, are shipped out of the port of Cavalla and are often known in the trade as Cavalla tobaccos. The name may also arise from the topography of the region in which they grow; thus Djebel refers to mountainous country, and Yaka refers to the hills in the mountainous regions. The name may also be derived from the name of a section of territory such as Souyalassi or Pravi.

The small leaf size of these tobaccos is obtained by growing the plants on relatively poor soils and by planting a large number of plants—40,000 to 70,000—per acre. If fertilizer is used it commonly consists of goat or sheep dung. The growing season after transplanting and during curing is usually dry and warm in these regions.

The tobacco is harvested by priming, the leaves being picked a few at a time as they ripen. After priming they are strung by piercing the large end of the midrib with a large needle and pulling the leaf onto the string. After the strings of leaves are allowed to wilt for 1–3 days in a cool shady place, they are placed in the sun and air and cured by means of these agents. During wilting and curing the leaves change from green to a brown or yellow color and lose most of their natural moisture content. After the leaves are cured they are stored in a protected place until they take up moisture again with the coming of damp autumn weather. They are then made into temporary bales and delivered by the grower to the dealer or exporter.

The tobaccos from the top part of the stalk are usually considered to be the best in quality, and those from the base the poorest. From 20–50% of the production of the plants of most crops is not imported into the United States because its quality does not warrant the payment of import duty.

The tobacco is delivered by the grower to the dealer or exporter for "manipulation." This consists of sorting, grading, and baling the tobacco in the preferred manner, for shipment and to facilitate fermentation. In recent years most Turkish tobaccos imported into the United States are baled in the so-called Tongas bale. This consists in placing the loose leaves in bales under pressure and sewing burlap covers securely to the bales. The bales vary in weight from 70 to 125 pounds.

The tobacco is usually stored for two or more years before it is used by the manufacturer. During storage it undergoes fermentation. In most instances this begins with the coming of warm weather and proceeds for a period of varying length depending upon the temperature conditions and the tobacco. It ceases with the arrival of cooler weather. The tobacco may undergo fermentation each summer until it is used. The temperature of the tobacco usually exceeds that of its surroundings during fermentation.

REVIEW OF LITERATURE

The literature contains but few data on the chemical composition of tobaccos of the Turkish type. Because of the limited scope of most of the investigations recorded in the foreign literature, they are not comparable, in many instances, to the data presented in this paper, nor do they aid in the interpretation of these data.

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Grading Room in Turkey

Andreadis and Toole (3), working with Greek tobaccos, show that the nicotine increases from the lower to the intermediate leaves on the stalk and again decreases in the top leaves. In another paper (2) the same authors show that the total nitrogen content follows the course of the nicotine and that protein nitrogen increases in the leaves from the base to the top of the stalk.

The work of Pyriki (19A) indicates that the better grades of Turkish tobaccos have a lower pH value than the poorer grades. Vladescu and Dimofte (24, 25, 26) determined total nitrogen, protein nitrogen, nicotine, soluble carbohydrates, and ash for Turkish, Greek, and Bulgarian tobaccos. Their data indicate that the better grades of tobacco possess the lower ash and nicotine content and the higher carbohydrate content. They also indicate, with some exceptions, a higher total nitrogen content in the poorer grades of tobacco. These authors find the total nitrogen, protein nitrogen, and nicotine content of the Bulgarian tobaccos to be lower than that of the Greek and Turkish tobacco, whereas the carbohydrate content of the former is higher. The ash content of the Greek tobaccos is somewhat greater than that of the other two. Their data show that the Smyrna tobaccos are lower in content of nitrogenous materials and higher in carbohydrates than the Samsun tobaccos. Also the Djebel tobaccos from both the Greek and Bulgarian regions are lower in nicotine content and higher in sugar content than any other tobaccos of the respective regions.

Kadir (13) discusses the blending of Turkish tobaccos for cigaret manufacture and gives the analysis of tobaccos of average grade from many sections of Turkey. His figures show that the composition of tobaccos growing in different major regions, such as Samsun on the Black Sea and Izmir in Southern Turkey, may vary widely and, furthermore, that there may be considerable differences in the composition of tobaccos from different areas within the same region.

Koseraif (14) gives some analyses of Turkish tobaccos which lead to similar conclusions as those drawn from Kadir's data.

METHODS OF ANALYSIS

MOISTURE. Two-gram samples in aluminum dishes were dried over concentrated (above 91%) sulfuric acid at 30° C. for 14 days.

HYGROSCOPICITY. The dried samples from the moisture determination were placed in an atmosphere of 72% relative humidity at 30° C. for a period of 14 days. The increase in weight on a percentage basis was termed the hygroscopicity.

PETROLEUM ETHER EXTRACT. Five-gram samples of the ground material were extracted for 23-24 hours with petroleum ether (boiling point 30-60° C.) on a Bailey-Walker extraction apparatus (27). The residue was dried to a constant weight at 95-98° C. in an electric oven.

ALCOHOL EXTRACT. The residue from the petroleum ether extract was extracted 23-24 hours with 95% ethyl alcohol on a Bailey-Walker extraction apparatus (27). The residue was dried to constant weight at 100-102° C. in an electric oven.

STARCH. The residue from the alcohol extract was used for the determination of starch by the diastase method with subsequent acid hydrolysis (4, p. 120).

NICOTINE. The Keller method as modified by Garner was used (10, 11).

PROTEIN NITROGEN. Two-gram samples were boiled for 10 minutes with 50 cc. of 0.5% acetic acid, and the mixture was filtered when cool. The residue was washed with hot 0.5% acetic acid until the filtrate was colorless. The nitrogen in the residue was determined by the Kjeldahl-Gunning-Arnold method (4, p. 8).

TOTAL NONVOLATILE ACIDITY. Five grams of tobacco and 6 cc. of 6 M hydrochloric acid were mixed into a homogeneous mass, and finely divided neutral pumice stone was later worked into it until a semidry mixture was obtained. This mass was extracted with alcohol-free ether for 40 hours or more in a Soxhlet extractor. The ether was removed by the addition of boiling water, and the acid-containing solution was boiled for 5 minutes to remove any volatile acids. The solution was made to a volume of 250 cc. at room temperature. Aliquots of 10 cc., to which 100 cc. of water had been added, were titrated for acidity with 0.1 N alkali using phenolphthalein as indicator. Chlorine was determined on other 10-cc. aliquots by the Mohr (18) method and its acid equivalent subtracted from the alkali titration. The results are expressed in the number of cc. of 0.1 N alkali required to neutralize the acidity in 1 gram of tobacco.

The amino nitrogen, water-soluble nitrogen, total reducing substances, total reducing sugars, and total sugars were determined on an extract made by extracting 25 grams of tobacco with 375 cc. of water in a Mason jar, with the addition of 1 cc. of chloroform at room temperature for 12 to 14 hours, with occasional shaking for the first hour. The pH was determined on an extract of the same proportions of tobacco and water but with the omission of the chloroform. The extracts were filtered through a linen cloth or a plug of glass wool.

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Hydrogen Ion Concentration. The Coleman glass electrode was used. The results were expressed in terms of pH.

Reducing and Total Sugars. Reducing sugars were determined before and after hydrolysis by the Munson-Walker method (4, p. 190), and the results expressed in terms of glucose. The extract was clarified with neutral lead acetate.

Total Reducing Substances. Total reducing substances were determined on the extract without clarification and after hydrolysis by the Munson-Walker method (4, page 190). The difference between the total reducing substances and the reducing sugars was called polyphenols[1].

[1] Wright (*20*) points out that an alternative interpretation of the so-called polyphenol content is possible in view of the statements in the literature. Pyriki (*10*) states that "it is perhaps correct" to consider that the difference between the *total reducing* substances and the total sugars are the polyphenols. Our data include values for both the reducing sugars and total sugars, which makes it possible to calculate the polyphenol values either way.

After reviewing the confused state of this matter in the literature we are of the opinion that a more correct value for the content of phenolic compounds would be obtained if the extract were hydrolysed first to convert all soluble sugars and soluble phenolic compounds into forms in which they would reduce Fehling's solution, and then determine the reducing power before and after clarification. If the clarification procedure removed all reducing materials other than soluble reducing sugars, the difference between the two values thus obtained for reducing power should more correctly represent the polyphenol content.

Table I. Regions, Areas, and Towns or Villages

Region	Area	Towns and Villages
Samsun (Black Sea)	Djannik	Kehyali, Haji, Ismailoglou, Sitma, Suyu, Tash Demir, Baldjari, Yagh Bassan, Hamsalu, Kara Oglan, Kokdje, Kishla, Buyuklu, Kir Pidjili
	Maden	Teke Keuy, Yokari Tsinik, Papas Mahallessi, Tsinik, Dvgherish, Assar Agatch, Okse, Andria Mah, Tsirakman, Ilyaskeuy
	Evgaf	Kertme, Dagh Keuy, Dus Keuy, Karagol, Tavlan, Manados, Kavadjik, Oyoumdja, Aksoular, Alanos, Tchobanli, Ballatch, Deredjik, Kadi Keuy
	Bafra	Ak Teke, Elifli, Kara Keuy, Teke Sarmousak, Dedeli, Orendjik, Ak Ghuneyi, Eimadjik, Koushlaghan, Kovanlik, Martakala, Dervent, Sourmeli, Deressi, Dar Boyas, Kush Kayassi, Domus Aghi
Smyrna (Aegean Sea)	Akhisar	Soma, Kirkagac, Akhisar, Gordus, Manisa, Sindirgi, Venice, Selendi, Marmara, Alibeyli, Hartu, Yayakoy, Suleymanli, Derekoy, Gelenbe
	Foca	Menemen, Foca, Dikili, Bergama, Ayvalik, Gomec, Jonuzlor, Demirtas, Acan, Sanakoyu, Kosah, Camanli, Akcenger, Kasaly, Guzelhisar
	Izmir	Izmir, Torbali, Buca, Seydikoy, Cumaovasi, Develi, Tarbali, Kayas, Burnova, Dikardas, Urlan, Cesme, Karaburun, Salman, Alcati, Demsyiren
	Mugla	Selcuk, Milas, Mugla, Bodrum, Akcaalan, Yalikavak, Kurukoy, Asin, Aydin, Yoran, Akkoy, Soke, Ula, Alacam, Boskoy, Karacahisar, Kemikler, Kasikli
Eastern Greece	Comontini	Komotini, Doukatan, Kasmion, Pandrossos, Genseti, Messi, Xvlagani, Krovyti, Maronia, Proskynital, Kerveli, Yeni Kioi, Bulat Kioi, Tsipeli, Semetli, Sendeli, Haskioi, Kiouplu, Esserdjil, Aghiasma, Yalendjali, Tchohadjiler
	Xanthi (2nd Yaka)	Kasos, Ghenissia, Evlalon, Tsimenli, Karakiosolou, Daoutlu, Kipseli, Kiosse Ali
	Djebel	Kechrokambo, Lekani, Dipotamon, Platamonia, Ptelea, Makaklov, Aronsout, Sarnovista, Yasriani, Isaidje
	Souyalasi	Kalitikes, Dafnon, Stavroupolis, Sarnits, Ada, Kourlar, Yenikioi
	Drama	Drama, Doxaton, Koudounia, Choristi, Kabanbaki, Fotolivi, Boriani, Radovista, Tsataldja, Karatzali
	Pravi	Drysna, Fteri, Amfipolis, Pravi, Avli, Eipia, Eleftherai, Pangaion, Mesoropis, Bostandjil, Nikisiani, Dranitsa
	Zihna	Mistrati, Melinos, Zihna, Thulon, Dratsova, Vitasta, Arghista, Rodolivos, Kotaskioi, Myrkinos, Nikisiani, Rahova, Gravisikta, Vultsista, Kioupkioi, Horovista
	Serres	Kastri, Kutsos, Kalimanli, Achires, Nigrita, Dimitritsi, Serrai, Neos, Skopas, [illegible], Christos, Dranova, Lacos, [illegible], Kitsissia, Karmaroio, Valtero, Strymonikon, Staros, Subaskioi, Doviata, Vertik, Soumousakti, Rahovistia, Topaliani
	Prossotsian	Granitis, Gornitsa, Egri-Dere, Prossotsian, Levska, Visatian, Plevna, [illegible], Kirlihova
Agrinion (Western Greece)	Agrinion	Agrinion, Stamna, Angelokastron, [illegible], Papadatais, Gavalou, Analipsis, [illegible], Trypotonas, Lepena, Neochori

Total Nitrogen. Kjeldahl-Gunning-Arnold method modified to include nitrates (4, p. 9) was used.

Water-Soluble Nitrogen. Kjeldahl-Gunning-Arnold method (4, p. 8) was used.

Amino Nitrogen. Van Slyke method (4, p. 245) was used.

Soluble Ash. Five-gram samples in tared porcelain crucibles were heated at 250° to 300° C. for 3 to 4 hours, then heated to a temperature of dull redness in a muffle for 14 to 16 hours, cooled to room temperature in a desiccator over calcium chloride, and weighed as total ash. The sand was determined, the difference between the total ash and sand considered to be soluble ash.

Sand, Silica, Oxides of Iron and Aluminum, Calcium, and Magnesium. These were determined by the official methods (4, pp. 39–41).

Phosphorus. Two-gram samples were dissolved in 30 cc. of concentrated nitric acid and 6 cc. of concentrated hydrochloric acid; organic matter was destroyed by boiling and phosphorus determined by the volumetric method (4, p. 3).

Sulfur. The magnesium nitrate method was used (4, p. 45).

Chlorine. This was determined by the official volumetric method (4, pp. 43–4).

Potassium. This was determined by the Lindo-Gladding method (4, p. 42).

SAMPLES

Each sample was taken from one individual bale, selected at random from a large number of bales available from each of the regions considered. The covers were removed from the bale and a section (1/20–1/10) of the bale was removed and taken to the laboratory. Part of this section was ground on a Wiley mill to pass a 30-mesh sieve, thoroughly mixed, and sealed in a glass jar until used for analysis.

The stock of bales available for selection consisted of bales of grades 1, 2, and 3, grade 1 being the best in quality. The number of bales of grade 3 was greater than the number of grades 1 and 2.

The tobacco in each of the bales selected for analysis was probably a mixture of leaves from numerous growers from several villages in the area surrounding the town for which the tobacco is named. It is possible, however, that the tobacco in any bale may have come from a restricted locality. The tobaccos of grade 1 may or may not have been from the same part of any community as those of grades 2 and 3.

TERRITORIES

For this work tobaccos from four marketing areas in each the Samsun and the Smyrna tobacco-producing regions of Turkey, nine areas in the Macedonian and Thracian regions of Greece, and one area in the Agrinion region of Greece were selected.

Tobaccos representative of the areas of Djannik, Maden, Evgaf, and Bafra of the Samsun region, and Akhisar, Foca, Izmir, and Mugla of the Smyrna region, were selected as being typical of those grown in Turkey. Tobaccos representative of Comontini, Xanthi (2nd Yaca), Souyalasi, Djebel, Drama, Pravi, Zihna, Serres, and Prossotsian in Eastern Greece and Agrinion in Western Greece were selected as being typical of those grown in Greece. The geographical locations of these areas are shown in the accompanying maps (Figures 1 and 2), and some of the towns and villages located in each area are given in Table I. All towns named are not necessarily tobacco-producing centers.

The villages from which the tobacco in the Samsun region were obtained all lie within 30 miles of the seacoast except for a few scattered villages in the Bafra area. In the Maden, Djannik, and Evgaf areas most of the tobacco is grown on hilly land, whereas in Bafra part of it is grown on the plain. The region in which Smyrna tobacco is grown is much larger, some of the areas extending inland from the sea as far as 60 to 80 miles. In this region most of the tobacco is grown on hillsides or high tablelands; a part of it, however, is grown on flatland in well drained valleys.

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TABLE II. PERCENTAGE[a] CHEMICAL COMPOSITION OF TOBACCOS GROWN IN TURKEY

Area	Grade	Crop	Total N	Protein N	Water-Sol. N	Amino N	Nicotine	Petroleum Ether Extract	Alcohol Extract	Starch	Reducing Sugar	Total Sugar	Total Reducing Substances	Polyphenols	Total Acids[a]	H Ion Concn. (pH)	Hygroscopicity	Sol. Ash	SiO_2	CaO	MgO	K_2O	$Fe_2O_3 + Al_2O_3$	P_2O_5	Cl_2	S
Samsun Region																										
Djannik	1	1937	2.53	1.08	1.43	0.347	0.70	4.65	33.49	3.87	6.22	7.48	8.06	1.83	21.63	4.83	15.06	12.21	1.48	2.32	0.96	4.03	0.82	0.81	0.68	0.40
		1938	2.62	1.06	1.39	0.365	0.76	3.95	27.49	2.77	5.13	5.56	7.82	2.69	25.50	4.99	14.58	14.08	1.44	4.19	1.00	4.09	0.59	0.76	0.65	0.33
	2	1937	2.45	1.04	1.51	0.334	0.90	4.85	29.71	3.24	6.34	6.60	8.09	1.75	21.61	4.86	14.71	15.39	1.19	3.73	1.01	4.07	0.60	0.87	0.59	0.33
		1938	2.66	1.05	1.45	0.361	0.90	5.27	25.30	2.51	4.13	5.62	5.47	1.34	24.98	5.07	14.12	15.22	1.23	4.60	1.13	3.86	0.62	0.77	0.54	0.36
	3	1937	2.92	1.21	1.72	0.407	0.67	4.40	28.09	3.43	5.11	5.32	6.93	1.82	22.51	4.99	14.55	16.74	1.60	4.35	1.20	4.05	0.92	0.86	0.78	0.35
		1938	2.97	1.24	1.57	0.491	0.69	5.38	23.15	2.39	3.88	4.23	5.09	1.26	27.37	5.13	13.72	15.48	1.16	4.65	1.26	4.00	0.55	0.77	0.71	0.38
Bafra	1	1937	2.88	0.98	1.70	0.374	1.29	5.48	31.09	2.19	5.96	7.05	7.21	1.35	24.96	4.76	15.58	12.18	1.38	3.74	0.91	3.59	0.44	0.70	0.66	0.48
		1938	2.75	1.05	1.63	0.380	1.11	4.28	29.93	2.68	4.79	5.31	6.77	1.98	22.80	4.88	13.85	13.23	1.23	3.83	1.07	4.21	0.51	0.76	0.36	0.44
	2	1937	2.96	1.08	1.80	0.420	1.50	5.34	28.92	2.73	4.36	4.75	5.88	1.47	26.16	4.79	14.82	14.50	0.91	4.38	0.92	4.07	0.40	0.77	0.55	0.40
		1938	2.09	0.95	1.61	0.350	1.52	5.41	29.85	2.96	5.58	6.24	7.50	2.01	24.09	4.90	13.12	12.54	1.47	5.04	1.00	3.69	0.54	0.71	0.42	0.40
	3	1937	2.08	1.09	1.88	0.460	1.49	4.53	31.76	3.27	5.24	5.57	6.60	1.26	21.86	4.82	14.87	13.72	0.91	4.40	1.09	2.47	0.28	0.77	0.83	0.44
		1938	3.28	1.30	1.94	0.533	1.55	4.91	26.36	2.38	3.71	4.13	5.06	1.35	25.16	4.93	12.86	14.36	1.81	4.36	1.15	3.48	0.74	0.68	0.72	0.43
Maden	1	1937	2.84	1.08	1.61	0.382	1.31	4.83	34.65	3.78	5.65	6.31	6.99	1.34	22.77	4.80	14.13	11.94	1.45	3.77	1.00	3.40	0.64	0.58	0.76	0.41
		1938	2.81	1.08	1.62	0.382	1.16	4.96	29.90	2.79	4.81	5.61	6.75	1.94	23.89	4.89	14.05	13.48	1.41	4.21	1.13	4.18	0.69	0.66	0.62	0.39
	2	1937	2.83	1.02	1.75	0.437	1.48	6.20	30.78	2.99	5.08	5.23	7.55	2.47	23.31	4.90	14.99	13.93	0.71	4.18	1.23	3.78	0.64	0.96	0.70	0.38
		1938	2.73	0.94	1.65	0.377	1.47	5.19	29.52	2.89	5.95	6.73	7.98	2.08	24.29	4.89	13.54	13.67	1.65	4.38	1.22	4.01	0.69	0.70	0.46	0.40
	3	1937	2.26	1.31	1.93	0.529	1.47	5.43	31.75	1.94	3.90	4.31	5.82	1.88	23.25	4.82	14.73	13.37	1.05	4.43	1.37	3.49	0.68	0.80	0.85	0.38
		1938	3.05	1.23	1.73	0.421	1.50	5.05	26.69	2.51	2.97	4.73	5.35	1.41	22.81	4.90	13.06	14.44	1.92	4.85	1.24	3.43	0.86	0.74	0.63	0.44
Evkaf	1	1937	2.74	0.99	1.59	0.377	1.54	5.32	32.30	3.36	5.84	6.51	7.76	1.92	23.74	4.80	13.83	13.34	1.89	4.22	0.89	3.32	0.57	0.63	0.62	0.49
		1938	2.92	1.02	1.75	0.406	1.33	4.62	30.29	2.70	4.63	5.30	6.54	1.91	25.70	4.85	13.20	13.23	1.53	4.13	1.00	4.13	0.74	0.67	0.62	0.43
	2	1937	2.81	0.97	1.72	0.405	1.72	6.45	30.02	2.86	4.74	5.11	5.94	1.20	23.03	4.80	13.80	13.33	1.07	4.00	0.89	3.88	0.66	0.77	0.42	0.44
		1938	2.99	0.99	1.81	0.345	1.40	5.68	29.59	2.24	4.80	5.44	6.47	1.67	25.06	4.93	13.48	13.81	1.18	4.52	1.19	3.95	0.58	0.81	0.47	0.36
	3	1937	3.10	1.15	1.80	0.409	1.57	5.55	30.00	2.85	4.80	5.23	6.34	1.54	22.45	4.80	13.36	13.95	1.25	4.72	1.17	3.50	1.01	0.77	0.72	0.42
		1938	3.43	1.22	2.04	0.527	1.73	5.63	25.26	2.15	2.93	3.12	4.56	1.63	25.41	5.10	13.40	14.96	1.85	4.48	1.22	3.96	0.87	0.69	0.71	0.42
Smyrna Region																										
Akhisar	1	1937	1.82	0.84	0.69	0.106	0.88	5.29	37.31	9.28	13.58	13.81	15.86	2.27	19.17	5.09	14.40	13.01	2.51	3.00	0.95	2.82	0.85	0.59	0.48	0.36
		1938	1.80	0.81	0.68	0.124	0.75	3.99	37.90	6.84	15.56	16.92	19.01	3.46	22.11	5.28	13.67	12.42	2.28	4.25	0.84	3.12	0.81	0.51	0.16	0.35
	2	1937	1.62	0.81	0.62	0.125	0.96	5.46	34.74	7.28	14.56	15.75	16.02	1.46	19.00	5.00	14.85	12.57	1.80	4.35	0.83	2.62	1.06	0.52	0.29	0.34
		1938	1.50	0.75	0.78	0.125	0.77	5.29	37.16	6.01	16.58	17.42	19.91	3.33	18.71	5.10	13.95	12.57	2.70	4.02	0.76	2.82	0.72	0.60	0.15	0.35
	3	1937	1.83	0.96	0.86	0.120	1.13	5.92	33.31	7.41	11.90	13.41	13.18	1.29	19.46	5.01	13.66	13.28	2.11	5.55	1.14	2.59	1.22	0.54	0.52	0.34
		1938	1.67	0.88	0.83	0.152	0.90	4.83	35.22	5.29	12.21	13.68	15.09	2.88	17.28	5.13	13.00	13.93	2.12	4.35	1.01	2.88	0.99	0.58	0.26	0.37
Izmir	1	1937	1.72	0.92	0.80	0.122	1.04	4.87	38.40	7.37	13.94	14.31	16.37	2.43	18.32	5.11	14.68	11.76	2.75	4.16	0.79	2.25	0.83	0.48	1.00	0.39
		1938	1.61	0.85	0.75	0.112	0.88	4.30	38.19	5.63	16.03	16.57	18.17	2.14	16.30	5.10	14.29	12.48	2.55	4.03	0.75	2.91	1.17	0.47	0.56	0.35
	2	1937	1.72	0.88	0.87	0.110	1.21	5.64	37.88	6.88	14.45	15.54	16.53	2.08	17.97	5.01	13.85	12.36	1.49	4.62	0.76	2.55	1.01	0.54	0.62	0.31
		1938	1.60	0.82	0.87	0.136	1.01	5.31	37.29	5.06	14.75	15.76	17.34	2.50	20.76	4.99	13.56	12.30	1.13	4.28	0.71	2.50	0.66	0.48	0.62	0.33
	3	1937	2.00	0.99	0.99	0.157	1.20	6.15	33.61	6.62	12.88	13.41	14.74	1.86	18.66	5.02	13.73	12.78	1.54	4.94	0.98	2.28	1.04	0.51	1.02	0.36
		1938	1.86	0.97	0.92	0.146	1.06	5.58	32.80	4.89	12.34	13.15	15.05	2.71	18.57	4.99	12.46	13.23	1.32	5.16	0.87	2.39	0.75	0.60	0.82	0.35
Foca	1	1937	1.89	0.94	0.71	0.102	1.00	6.46	35.24	8.31	14.28	14.85	17.23	2.95	16.93	4.98	15.27	11.18	2.33	3.82	0.85	2.36	0.67	0.44	1.10	0.38
		1938	1.65	0.94	0.75	0.115	0.91	4.92	35.83	6.20	14.23	14.74	15.61	1.38	16.96	4.89	12.89	12.04	1.99	3.80	0.77	3.08	0.77	0.47	0.95	0.42
	2	1937	1.64	0.88	0.79	0.109	1.06	6.82	35.80	8.51	13.35	14.92	15.01	1.06	17.91	4.99	14.10	13.04	1.61	3.89	0.83	2.97	0.87	0.54	0.96	0.34
		1938	1.63	0.81	0.76	0.109	1.01	5.64	35.88	6.06	14.96	16.13	17.97	3.01	17.64	4.93	13.58	12.28	2.17	3.70	0.79	2.87	0.82	0.57	0.57	0.35
	3	1937	1.01	0.96	0.92	0.128	1.24	6.21	28.59	7.11	11.41	13.12	12.77	1.36	23.02	5.00	13.83	13.64	1.73	5.02	1.06	2.90	1.00	0.45	0.86	0.38
		1938	1.90	0.96	0.94	0.130	1.12	5.77	34.17	4.45	15.38	16.33	17.55	2.17	18.39	4.91	13.31	13.54	2.39	3.92	0.94	2.96	0.50	0.58	0.72	0.38
Mugla	1	1937	1.51	0.88	0.68	0.100	0.78	5.31	36.45	8.09	14.41	14.87	17.56	3.15	17.48	5.19	14.26	11.75	2.90	4.00	0.06	1.96	0.92	0.44	0.74	0.33
		1938	1.44	0.79	0.65	0.111	0.57	3.45	36.08	7.48	16.90	17.49	18.78	1.88	17.00	5.09	12.81	13.15	2.94	3.79	0.75	2.91	1.19	0.56	0.48	0.34
	2	1937	1.50	0.81	0.75	0.127	0.78	5.92	34.09	8.55	15.30	15.96	16.76	1.46	17.65	5.10	13.37	13.01	1.36	4.79	0.63	2.30	1.00	0.53	0.62	0.28
		1938	1.51	0.78	0.60	0.117	0.74	5.53	35.37	6.18	15.68	16.27	18.14	2.46	16.35	4.94	14.06	13.71	2.15	3.81	0.68	2.62	0.69	0.60	0.51	0.30
	3	1937	1.88	0.97	0.87	0.129	1.04	5.48	33.35	7.62	11.22	12.28	13.56	1.34	21.90	5.00	12.64	13.75	2.08	5.12	0.96	2.50	1.37	0.54	0.86	0.28
		1938	1.74	0.93	0.76	0.127	0.76	5.67	32.45	5.06	12.28	13.31	14.87	2.50	19.72	5.00	13.31	13.80	2.06	4.55	0.90	2.37	1.01	0.61	0.67	0.32

[a] Expressed as cc. of 0.1 N alkali required to neutralize the acid in 1 gram of tobacco.

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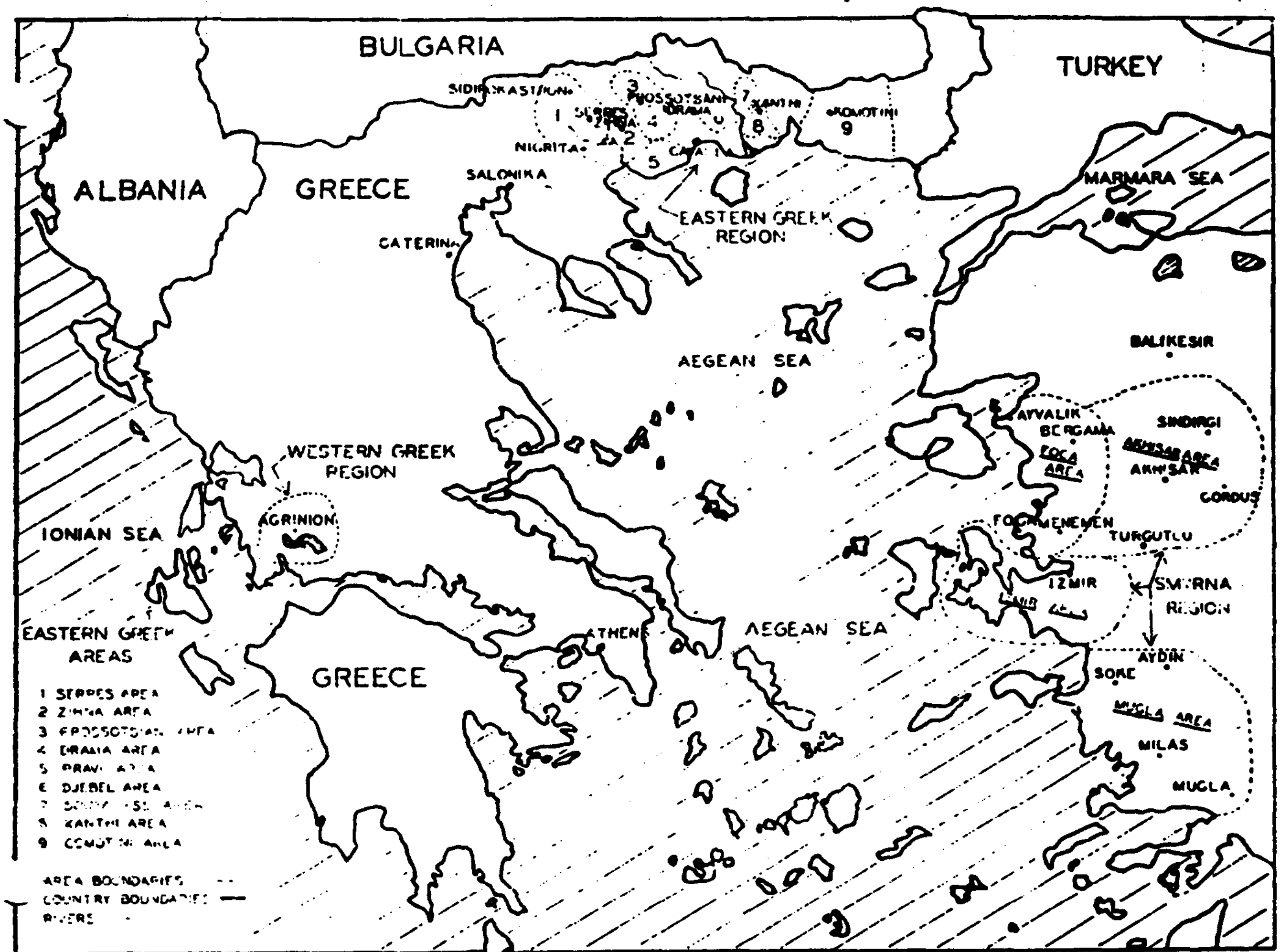
Source: https://www.industrydocuments.ucsf.edu/docs/fzbl0016



MAP OF GREEK AND SMYRNA PRODUCING REGIONS AND AREAS
FIGURE NO.1

The areas in the Eastern Greek region from which tobaccos were selected lie within 35 miles of the Aegean sea or its arms, with the exception of parts of the Serres and Prossotsiani areas. In general, this territory is mountainous, but much of it is constituted of small valleys. The tobacco-growing land extends from the banks of the streams and small rivers that flow through the valleys to the sea, into the hills and mountains that border these valleys.

The city of Agrinion is located in the tobacco-growing region of that name in Western Greece. The tobacco was obtained from an area within a radius of 15 miles of Agrinion. The region is generally mountainous with some flatland lying west of Agrinion.

DISCUSSION

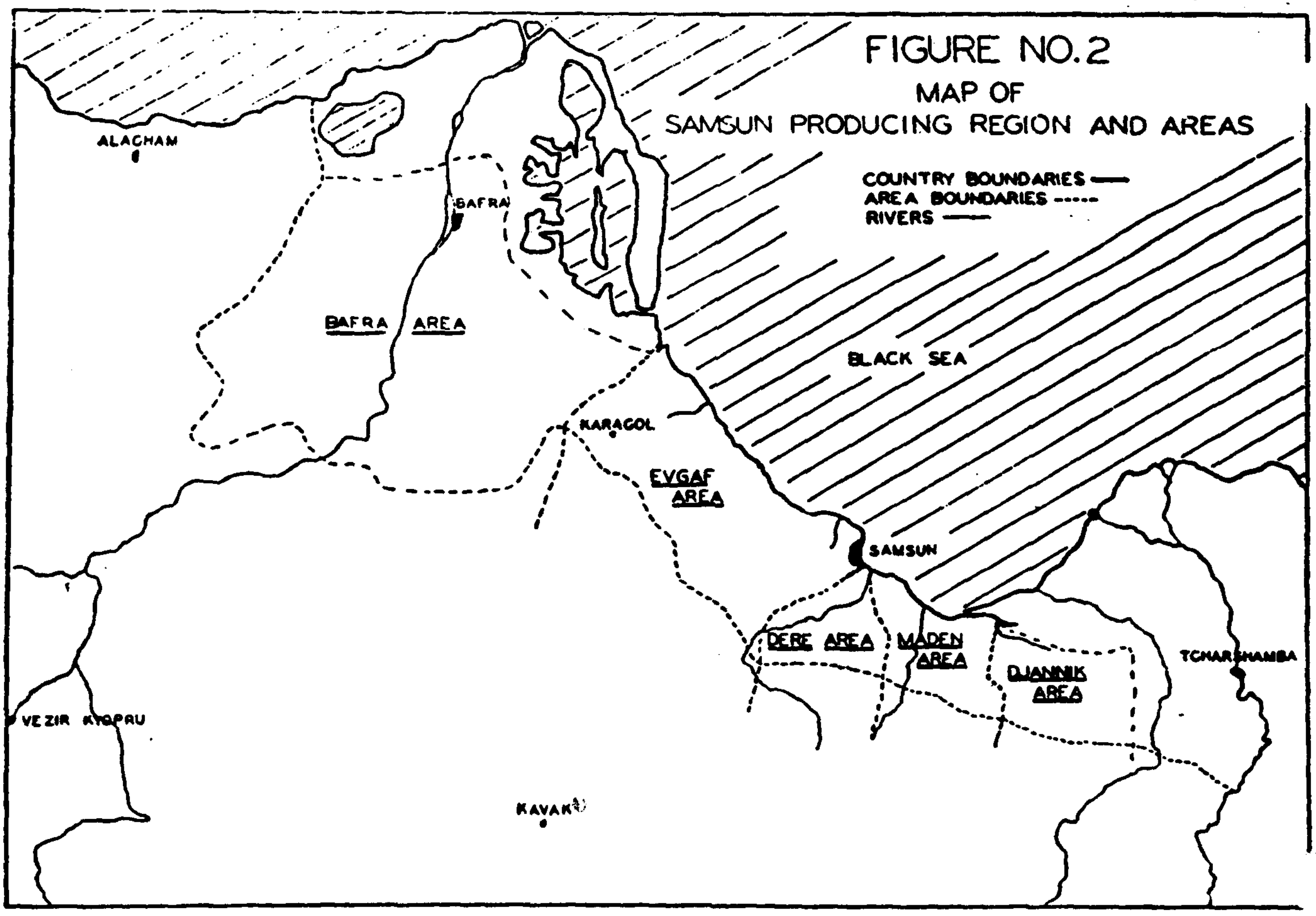
The data for twenty-four chemical constituents or properties of each of the samples analyzed are given in Tables II and III.

As would be expected, there is rather wide variation in some cases between the content of certain constituents in tobaccos of the same grade from year to year and from area to area in each of the regions. The average content of the constituents for the whole group of samples is quite similar for each of the two years. This similarity holds for each grade from year to year. These average data are given in Table IV. Also the trend from grade to grade [illegible] definite when the data on all samples are considered as a whole. This trend, however, fails to hold in many individual cases. The data show that the tobacco from each of the three main regions is quite different chemically. They also show that tobaccos from different areas within a specific region may be quite similar in chemical make-up in some cases and different in others.

Information on such points as weather, production, fertilisation, and soil fertility, from which an adequate explanation of these differences could be formulated, is not at hand. The practice of many importers—obtaining tobaccos from as many areas as possible within a region and then blending the tobaccos from each—indicates that these differences in chemical compositions reflect real differences in the tobaccos and that these are recognised in commercial practice.

NITROGENOUS CONSTITUENTS. The data for the individual samples in Tables II and III show that the content of the nitrogenous components varies over a wide range. On the other hand, the data in Table IV show that the average content for these constituents is essentially the same for each of the 1937 and 1938 crops. Isolated cases, however, can be found in Table III where the contents of these materials are rather divergent for the two years. For instance, they are highest in the Souyalassi tobaccos of the 1938 crop, whereas they are highest in the Comotini tobaccos of the 1937 crop.

With the exception of the protein nitrogen, the average content of these constituents is least in the tobacco of grade I and most in that of grade 3. The average protein nitrogen content of the tobacco of grade 3 is greater than that of the tobacco of grades 1 and 2; these are essentially the same, with slightly less in grade 2 than in grade 1. This decreased nitrogen content in the tobacco from the upper portion of the stalk (grade 1 is considered to be



mainly from the top of the stalk) is at variance with the behavior of cigar tobaccos (1) and flue-cured cigaret tobaccos (7) where the nitrogen content is usually maximal in the tobacco grown on the top part of the stalk. However, in respect to grade it is in accordance with the findings for cigaret tobacco (7), the better cigaret tobaccos being of a low and medium nitrogen content. Perhaps this decreased nitrogen content in the top leaves may be due to the limited supply of nitrogen available to the plant, this being due in turn to the low level of fertility of the soil and the loss of nitrogen from these leaves to the seed head. The seed head is formed late in the life of the plant and frequently is not removed from the plant.

The average content of protein nitrogen in the tobaccos varies but little between the four major regions represented.

The average nicotine content of the tobaccos from the Samsun, Eastern Greece, and Agrinion regions is similar, varying from 1.29 to 1.34%. That of the tobacco from the Smyrna region, however, is much less, being only 0.96%. The average content of total nitrogen, water-soluble nitrogen, and amino nitrogen of these tobaccos varies considerably from region to region. The data in Table IV, with the exception of nicotine, show that as one of these constituents varies the others vary; the gradation of these constituents from Samsun to Smyrna through the Greek tobaccos is shown in Figure 3. In this figure an arbitrary linear scale was selected for the total nitrogen content of these tobaccos from the different geographical regions; the Samsun tobacco was arbitrarily given a value of 1, Eastern Greek tobaccos a value of 2, the Agrinion tobacco 3, and the Smyrna 4. If the other nitrogen constituents are plotted against the same arbitrary index, the striking result is found that (with the exception of nicotine) essentially linear relations exist for these constituents.

This same index of gradation in tobacco composition from region to region also gives *surprisingly good linear relations* for the carbohydrate type of constituents. This is shown by the curves for carbohydrate constituents in Figure 3. The juxtaposition of the curves for nitrogenous constituents and carbohydrate constituents in Figure 3 emphasizes again the relations found in previous work as characteristic of the flue-cured type of tobacco (6, 7, 8). These may be stated briefly as follows: (*a*) If one nitrogen constituent is high the others are high; (*b*) if nitrogenous constituents are high, the sugar constituents are low; and (*c*) if total nonvolatile acids are high the carbohydrate constituents are low. The large amount of data presented in Tables II, III, and IV (much of which will not be mentioned specifically in the discussion) indicates quite clearly that the Turkish tobaccos show similar trends in their chemical composition.

This indicates that those factors influencing growth, which originate from the soil and climatic differences existing in the middle East region where these tobaccos were grown, operate in essentially the same manner as those influences which determine the differences in flue-cured types from different regions (6). If this principle is valid, as it seems to be, it is of considerable importance, as it will permit application of the extensive knowledge already available (6, 7, 8) regarding the effects of varying cultural and fertilization practices on tobaccos of the flue-cured type, and lead to more intelligent procedures in producing tobaccos of the Turkish type.

This knowledge has already been applied in field work now in progress. Thus it has been possible to reduce greatly the amount of phosphorus available to the plant so as to delay flower formation. This results in a slower maturing plant, which in turn gives the grower a longer period over which to spread the manual work required in harvesting.

The percentage of total nitrogen which is water soluble is greatest

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Source: https://www.industrydocuments.ucsf.edu/docs/fzbl0016

TABLE III. PERCENTAGE* CHEMICAL COMPOSITION OF TOBACCOS GROWN IN GREECE

Area	Grade	Crop	Total N	Protein N	Water-Sol. N	Amino N	Nicotine	Petroleum Ether Extract	Alcohol Extract	Starch	Reducing Sugar	Total Sugar	Total Reducing Substances	Polyphenols	Total Acids*	H Ion Concn. (pH)	Hygroscopicity	Sol. Ash	SiO_2	CaO	MgO	K_2O	$Fe_2O_3 + Al_2O_3$	P_2O_5	Cl_2	S
Eastern Greece Region																										
Zihna	1	1937	2.15	0.96	1.11	0.231	0.87	6.11	35.57	4.66	11.85	12.33	14.47	2.62	20.85	4.80	13.65	10.95	1.82	5.45	0.65	2.02	0.48	0.52	0.81	0.51
		1938	2.31	0.96	1.16	0.219	1.04	4.56	35.83	4.28	12.73	14.55	15.08	2.35	20.37	4.86	12.85	11.25	1.50	4.89	0.69	2.51	0.64	0.55	0.60	0.42
	2	1937	2.54	0.94	1.47	0.303	1.70	6.86	30.70	2.17	9.63	10.05	11.86	2.23	25.37	4.80	15.47	11.59	0.92	5.38	0.73	2.36	0.55	0.58	0.62	0.40
		1938	2.53	0.91	1.55	0.305	1.68	6.39	31.15	2.65	9.85	10.61	12.79	2.93	25.73	4.95	13.49	14.66	1.24	6.05	0.69	2.73	0.48	0.54	0.43	0.45
	3	1937	2.83	1.05	1.64	0.410	1.65	6.55	29.58	1.66	6.99	7.55	8.54	1.55	27.09	4.98	15.36	13.02	0.83	5.23	0.71	2.42	0.61	0.55	0.50	0.46
		1938	2.55	0.96	1.47	0.272	1.34	5.40	31.72	3.08	11.23	12.07	12.95	1.72	24.48	4.93	14.91	14.28	1.26	5.97	0.78	2.33	0.50	0.51	0.63	0.42
Pravi	1	1937	2.36	1.11	1.14	0.207	0.93	5.88	35.24	5.01	12.79	13.21	10.35	3.56	18.84	4.61	14.82	9.94	1.43	3.78	0.92	2.44	0.43	0.64	0.89	0.47
		1938	2.76	1.17	1.41	0.248	1.39	4.40	34.73	4.26	11.68	13.05	14.14	2.46	19.11	4.61	13.06	11.08	1.68	3.51	0.88	2.85	0.73	0.69	1.00	0.38
	2	1937	2.56	1.06	1.40	0.218	1.49	7.04	32.84	4.77	11.46	12.22	14.17	2.71	21.83	4.60	14.72	10.25	0.71	3.82	0.75	2.93	0.49	0.72	0.67	0.42
		1938	2.92	1.19	1.54	0.281	1.51	7.25	33.45	2.90	10.50	11.52	12.67	2.17	22.34	4.66	12.86	11.54	1.08	2.95	0.87	2.54	0.66	0.69	0.75	0.34
	3	1937	2.69	1.05	1.53	0.303	1.15	6.92	28.36	3.19	9.43	9.90	11.59	2.16	22.93	4.75	16.00	11.79	0.88	4.39	0.97	3.01	0.50	0.66	0.82	0.38
		1938	3.36	1.39	1.82	0.341	1.61	5.67	30.22	2.65	8.52	9.38	10.07	1.55	22.44	4.70	12.41	12.09	1.25	4.46	1.06	2.63	0.56	0.66	0.82	0.36
Serres	1	1937	2.52	1.00	1.39	0.268	1.64	6.79	31.51	3.33	7.89	8.30	10.25	2.36	23.12	4.91	13.18	12.47	2.08	5.38	0.78	2.31	0.97	0.55	0.71	0.39
		1938	2.39	0.95	1.33	0.217	1.43	4.13	28.42	4.20	11.37	12.92	13.47	2.10	22.80	4.78	13.15	11.61	1.55	5.24	0.85	2.41	0.69	0.51	0.77	0.42
	2	1937	2.85	0.95	1.79	0.379	2.17	7.52	27.70	2.05	6.19	6.52	7.21	1.02	23.65	4.92	14.04	12.85	1.61	5.48	0.79	2.90	0.77	0.62	0.69	0.49
		1938	2.63	0.92	1.58	0.246	2.23	7.13	30.67	2.78	8.39	9.09	11.13	2.74	21.28	4.85	12.66	15.51	1.20	5.80	1.03	2.14	0.70	0.51	0.81	0.44
	3	1937	2.92	0.98	1.81	0.433	2.27	7.39	25.77	1.77	4.40	4.82	5.32	0.92	26.88	5.01	13.31	13.98	1.24	5.84	0.82	2.58	0.99	0.59	0.80	0.42
		1938	2.80	1.02	1.77	0.297	2.26	6.18	28.60	2.83	7.99	8.61	9.68	1.69	22.01	4.90	12.82	16.41	1.24	6.37	1.01	2.70	0.74	0.51	0.81	0.39
Drama	1	1937	2.58	1.11	1.38	0.269	1.69	6.58	31.82	3.75	7.37	7.98	10.00	2.63	22.17	4.74	13.76	12.14	1.69	4.62	0.90	2.48	0.66	0.72	1.13	0.37
		1938	2.64	0.99	1.45	0.253	2.08	5.38	27.70	2.74	8.48	9.84	10.63	2.15	25.01	4.79	13.50	12.55	0.95	5.61	0.90	2.70	0.82	0.60	0.89	0.40
	2	1937	2.58	1.02	1.51	0.305	1.77	8.31	28.47	2.90	6.19	6.86	7.80	1.61	20.76	4.77	14.39	11.54	0.92	4.59	0.79	2.61	0.52	0.77	0.80	0.37
		1938	2.72	1.04	1.57	0.231	1.98	7.21	31.48	2.05	8.69	9.06	10.71	2.02	19.81	4.78	14.14	13.37	1.41	5.22	0.85	2.59	0.71	0.57	0.98	0.36
	3	1937	2.79	1.06	1.65	0.370	1.81	7.12	24.57	2.03	4.73	5.08	6.04	1.31	25.91	4.99	14.15	13.80	1.22	5.59	1.02	2.96	0.69	0.70	0.83	0.38
		1938	2.83	1.10	1.64	0.249	2.16	7.24	29.48	2.54	7.71	8.06	9.19	1.48	24.21	4.81	12.65	14.46	1.69	5.43	0.93	2.23	0.90	0.60	0.83	0.36
Djebel	1	1937	1.88	0.87	0.91	0.140	0.45	4.24	38.48	6.48	18.83	19.13	21.48	2.65	17.08	4.65	16.38	10.04	1.74	2.74	0.65	2.97	0.49	0.65	0.50	0.51
		1938	1.92	0.90	0.96	0.161	0.45	3.69	37.59	5.94	17.90	18.25	20.00	2.10	18.20	4.60	15.30	9.85	1.32	3.20	0.88	2.33	0.59	0.64	0.76	0.39
	2	1937	2.10	0.93	1.11	0.167	0.82	4.94	33.45	6.20	15.62	16.81	17.24	1.62	16.22	4.67	14.83	11.84	0.55	3.32	0.74	2.85	2.50	0.66	0.63	0.41
		1938	2.67	1.11	1.48	0.267	0.94	5.82	33.87	4.81	12.38	13.15	15.07	2.69	19.58	4.53	14.91	11.28	1.17	3.33	0.89	2.61	0.49	0.65	0.74	0.50
	3	1937	2.44	1.07	1.31	0.264	0.95	5.07	31.85	4.64	11.15	12.16	13.73	2.58	18.79	4.87	13.70	12.02	0.66	4.13	0.90	3.84	0.49	0.65	0.67	0.55
		1938	3.41	1.30	1.95	0.451	1.32	6.12	30.19	3.07	6.90	7.37	8.60	1.70	21.96	4.81	15.09	15.29	1.45	4.42	1.19	3.49	0.71	0.68	1.17	0.50
[illegible]onyalassi	1	1937	1.96	0.96	0.95	0.195	0.47	5.58	38.63	3.94	16.95	17.64	19.69	2.74	15.95	4.60	16.01	10.00	1.81	2.91	0.78	2.10	0.48	0.68	0.85	0.47
		1938	2.33	1.08	1.10	0.210	0.62	4.30	38.86	6.11	16.89	17.42	20.89	4.00	16.92	4.52	15.00	9.99	1.63	2.86	0.80	2.82	0.50	0.65	0.77	0.42
	2	1937	1.98	0.90	1.08	0.178	0.61	4.39	37.33	5.30	17.75	18.32	20.58	2.83	16.12	4.62	14.21	11.00	0.47	3.13	0.61	3.02	0.34	0.70	0.32	0.40
		1938	2.69	0.96	1.65	0.255	0.85	5.48	34.48	4.21	13.32	14.95	16.57	3.23	20.22	4.59	17.35	11.90	1.16	3.17	0.85	2.81	0.74	0.70	0.63	0.34
	3	1937	2.29	1.04	1.17	0.238	0.61	4.95	35.20	4.94	14.80	15.38	16.84	2.04	15.80	4.69	13.58	11.82	0.66	3.19	0.75	3.09	0.45	0.70	0.65	0.52
		1938	3.02	1.15	1.69	0.272	0.95	5.21	32.29	2.59	10.71	11.02	13.05	2.34	19.92	4.72	17.73	14.25	1.24	4.24	0.97	2.85	0.65	0.65	0.83	0.42
Xanthi (2nd Year)	1	1937	2.62	1.20	1.33	0.237	1.19	5.82	35.86	5.44	11.33	11.66	13.74	2.41	19.80	4.72	14.80	11.18	1.93	4.84	0.89	2.45	0.77	0.52	1.10	0.39
		1938	2.72	1.14	1.46	0.283	1.11	5.53	34.56	3.39	9.14	9.79	13.28	4.14	20.87	4.59	13.27	11.98	1.75	4.01	1.08	2.82	0.83	0.65	1.34	0.45
	2	1937	2.90	1.13	1.64	0.285	1.74	8.76	29.30	3.67	7.98	8.31	10.73	2.75	19.20	4.67	12.21	11.59	1.09	4.30	0.90	3.12	0.75	0.58	0.81	0.37
		1938	2.95	1.03	1.76	0.340	1.53	7.65	31.71	2.16	8.29	8.70	10.33	2.04	19.87	4.60	16.71	13.99	1.18	4.59	1.21	3.06	0.75	0.54	1.34	0.41
	3	1937	3.26	1.23	1.86	0.373	1.71	7.72	27.03	3.25	6.08	6.51	7.88	1.80	22.84	4.83	15.48	13.41	1.12	5.88	1.00	3.12	0.54	0.59	1.01	0.46
		1938	3.32	1.18	2.12	0.304	2.01	7.96	27.97	1.63	5.47	5.72	6.07	1.20	24.21	4.90	16.02	16.47	1.30	4.88	1.13	3.11	0.88	0.59	1.13	0.47
Comotini	1	1937	2.29	1.05	1.11	0.195	0.93	5.67	35.50	4.90	12.06	12.45	13.84	1.78	20.00	4.62	14.36	11.50	2.23	3.79	1.00	2.17	0.75	0.58	1.10	0.37
		1938	1.87	0.92	0.89	0.148	0.47	2.82	37.18	7.31	18.50	19.48	20.92	2.42	17.79	4.69	15.25	9.30	1.29	3.45	0.63	2.31	0.40	0.67	0.54	0.31
	2	1937	2.14	0.99	1.37	0.182	1.18	7.40	33.80	5.78	12.83	13.43	14.93	2.10	17.91	4.69	17.25	10.63	0.79	3.65	0.87	2.71	0.58	0.72	0.70	0.33
		1938	2.35	0.97	1.35	0.251	1.04	6.11	33.55	3.61	12.27	12.82	13.19	2.92	18.31	4.60	14.74	13.27	1.46	3.83	1.10	2.86	0.72	0.56	1.12	0.46
	3	1937	2.84	1.11	1.57	0.381	1.43	7.72	27.31	2.45	6.78	7.28	8.05	1.27	24.47	4.89	16.65	14.35	1.20	4.84	1.11	3.41	0.88	0.64	0.99	0.42
		1938	2.50	1.01	1.38	0.273	1.22	6.70	30.69	3.21	10.17	10.64	12.54	2.37	20.31	4.80	14.76	15.46	1.73	4.40	1.14	3.33	0.78	0.56	1.12	0.47
Prosotsian	1	1938	2.31	0.98	1.21	0.203	1.02	5.33	35.34	4.52	13.09	14.42	16.36	3.27	20.06	4.52	13.80	11.75	0.71	4.99	0.75	2.40	0.77	0.61	0.60	0.41
	2	1938	2.61	0.90	1.63	0.288	1.50	7.23	30.17	2.29	9.60	10.31	11.04	1.44	23.26	4.62	15.99	13.94	1.00	5.03	0.79	2.97	0.60	0.62	0.36	0.48
	3	1938	2.67	1.02	1.53	0.327	1.34	6.31	26.92	2.72	9.10	9.60	10.70	1.60	24.70	4.90	15.95	14.96	1.14	5.68	0.96	2.64	0.70	0.52	0.54	0.45
Western Greece Region																										
Agrinion	1	1937	2.01	0.81	1.13	0.208	1.33	5.23	34.03	4.00	11.10	11.73	14.27	3.17	21.81	4.99	15.22	14.95	1.08	4.40	0.63	3.79	0.42	0.51	0.83	0.58
		1938	2.05	0.94	1.02	0.186	1.28	4.59	40.95	5.56	11.42	12.26	13.46	2.04	19.20	4.89	14.77	11.77	0.72	4.82	0.75	3.00	0.61	0.52	0.94	0.42
	2	1937	2.08	0.92	1.13	0.212	1.06	7.16	32.88	4.20	11.38	12.26	13.63	2.25	17.85	4.81	15.06	13.70	1.06	4.10	0.70	2.95	0.39	0.64	0.78	0.43
		1938	2.04	0.87	1.12	0.184	1.20	6.33	33.43	4.06	12.89	14.73	15.11	2.22	18.89	4.93	17.47	13.67	0.94	4.06	0.72	3.14	0.50	0.50	0.78	0.41
	3	1937	2.37	1.04	1.26	0.190	1.51	7.07	31.33	3.75	9.67	10.64	11.44	1.77	20.46	4.90	14.49	12.88	1.33	4.53	0.74	3.07	0.49	0.50	0.77	0.39
		1938	2.24	0.98	1.19	0.218	1.49	6.47	31.46	4.55	10.96	11.68	12.86	1.90	22.12	5.00	16.73	15.43	1.21	4.67	0.82	3.07	0.50	0.46	0.84	0.46

* Total acids expressed as cc. of 0.1 *N* alkali required to neutralize the acid in 1 gram of tobacco.

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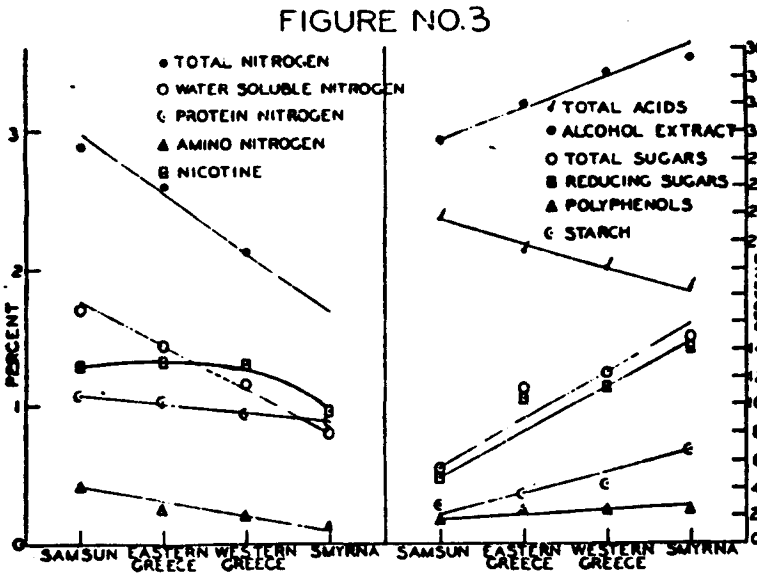
FIGURE NO.3



in the tobaccos grown in the Samsun region, least in those grown in the Smyrna region, and intermediate for those grown in Greece. Unpublished work of this laboratory indicates that most of the nitrogen content of tobaccos of these types is in the insoluble form when the leaves are harvested, and that the nitrogen in soluble form tends to increase in amount until the moisture content of the tobacco becomes too low. The work of Smirnov (*21*) also indicates a loss in protein nitrogen during curing.

The tobaccos grown in the Smyrna region were probably cured more rapidly, because of the hot, dry climate of that region, than those grown in the Samsun and Greek regions. This condition may have reduced the moisture content to unfavorable proportions for the conversion before a larger percentage of the nitrogen was changed to the soluble form.

The lower total nitrogen and amino nitrogen content of the Smyrna tobaccos would seem to indicate that they were grown with less nitrogen available to the plant or that the leaves were more mature at the time of harvest; probably both were contributing factors. The high total nitrogen content of the Samsun tobaccos probably originates from the facts that they were produced on better soils and harvested when less mature. High amino nitrogen content indicates immaturity, a conclusion supported by unpublished work of this laboratory.

The contents of the nitrogenous constituents of the tobaccos from each of the four areas in the Smyrna region are not very different from one another; this indicates a uniformity in soil types, climatic conditions, and cultural practices in the entire region.

The content of nitrogenous constituents of the tobaccos from the Bafra, Maden, and Evgaf areas of the Samsun region is somewhat greater than that of the tobaccos from the Djannik area.

The content of the nitrogenous constituents varies considerably from area to area in the Eastern Greek region. It is greater, however, in the tobaccos produced in the Zihna, Pravi, Serres, Drama, and Prossotsian areas, which are in the western part of the region, and less in the Souyalassi, Dejebel, and Comotini areas, which are in the eastern part of the region. This may be a partial explanation for the division of the tobaccos into Cavalla and Xanthi types as is frequently practiced by the trade. The content of nitrogenous constituents, however, is larger in the tobacco from the Xanthi (2nd Yaca) area than in any other tobacco produced in the region. There is no apparent reason for this exception.

Petroleum Ether Extract. Low boiling petroleum ether removes wax and fatlike materials from the tobacco tissue. These substances are primarily protective materials, and their content may be affected considerably by the weather conditions (*7*) which prevail shortly before harvest. The absence of weather data precludes any adequate discussion or valid correlations in this case.

The data in Table IV show that tobacco of the 1937 crop was 0.55% higher in the extract than that of the 1938 crop, and that grade 1 contains 1% less of the extract than grades 2 and 3. They also show that the tobacco from the Samsun region contains the least amount of the extract, whereas that from the Greek regions contains the greatest amount.

The data in Table II show that the extract content is consistently less in the tobaccos of the 1938 crop from the Smyrna region. This would tend to indicate that dryer, hotter weather prevailed in 1937 in this region. For the Samsun region they show that the variation in extract content is not consistent within the region or for the grades within a specific area of the region.

The data in Table III show a general definite trend toward a greater content of the extract in the 1937 crop for the Eastern Greek tobaccos. They also show that the tobacco from the Djebel and Souyalassi areas contains much less of the extract than the tobaccos from any other area of the region. Table III shows that the content of the extract varies from 2.82 to 8.76% for individual samples. These variations among samples are much greater for the tobaccos from the Eastern Greek region than for those from the Samsun and Smyrna regions, which probably indicates that either the weather conditions were more variable or the grading practice was less efficient in the Eastern Greek region.

Other factors being equal, the smaller the petroleum ether extract the better the burning quality and the poorer the aromatic qualities. If this is correct, the data tend to lend validity to the contention that the Samsun tobaccos are most desirable for general blending qualities, while the Smyrna and many of the Eastern Greek tobaccos are desired if a greater intensity of aroma is required in the blend.

Carbohydrate and Acid Constituents. Tables II and III show the wide range in content of carbohydrate material found in these tobaccos; Figure 3 shows the relation of other carbohydrate constituents to one another when they are plotted in an arbitrary manner, as was done for the nitrogenous constituents. As the sugar type materials increased the acids decreased.

The alcohol extract contains a conglomerate mixture of materials. The main part, however, consists of sugar, acid, protein, gum, and resinlike substances. The data in Table IV and Figures 3 and 4 show that in general the larger the amount of alcohol-soluble material found in a tobacco, the larger the amount of soluble sugar materials and the smaller the amount of nitrogenous materials it contains.

Figure 4 also indicates, as has been observed previously for the flue-cured type of cigaret tobacco (*7*), that as the soluble sugar content increases the total acid content decreases. In the case of the alcohol extract, sugar, starch, and polyphenols, Figures 3 and 4 show that as one of these constituents varies, each of the others do also. Unpublished work of this laboratory indicates that the aromatic principle of tobacco of this type is included in the alcohol extract. The specific constituents from which the aroma arises, however, have not been identified.

The difference between the total sugars and reducing sugars is a measure of the disaccharides present in the tobacco. In general, the greater the total sugar content the greater the content of disaccharides.

The gradation of the sugar-containing constituents from Smyrna to Samsun and from grade 1 to grade 3 is clearly shown in

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Source: https://www.industrydocuments.ucsf.edu/docs/fzbl0016

Figures 3 and 4, and the data in Table IV show the average content to be essentially the same for each of the two years.

The average content of these materials for each of the areas in the Samsun and Smyrna regions varies but little. In the case of the Eastern Greek region, however, a division occurs; the tobaccos from the western part or those from the Serres, Drama, Zihna, Pravi, and Prossotsian areas contain less of these constituents than do those from the eastern part. This again supports the practice of dividing geographically the tobaccos from this region into two classes, Cavalla and Xanthi, as is usually done in the trade. Again, as in the case of the nitrogenous materials, the tobacco of the Xanthi area is not similar in carbohydrate composition to tobaccos from neighboring areas.

The average starch content of the tobaccos from the Smyrna region is greater than that of the tobaccos from the other regions, that of the Samsun region being least. The starch content is greatest in grade 1 tobacco and least in grade 3. The tobacco of the 1937 crop contained more starch than that of the 1938 crop. The starch content of tobacco from each area in the Samsun region is low, that of each area in the Smyrna region is high, and that of the areas in the Eastern Greek region is rather variable. In general, it is higher in those tobaccos grown in the eastern part of the region.

It is generally conceded (*9, 23*) that the starch content of freshly harvested tobacco is high while the soluble sugar content is low, that the soluble sugars are formed by the conversion of starch to sugars, and that the cured tobaccos are higher in sugar and lower in starch content; unpublished work on curing in this laboratory confirms this. Air-cured tobaccos, when cured over a prolonged period, are low in soluble sugar content (*5, 12*), whereas flue-cured tobaccos, when cured rapidly, are high in soluble sugar content (*6*).

It was pointed out previously that the 1937 growing and curing season was probably dryer and warmer than the 1938 season, and that the Smyrna region is generally much dryer and warmer than the Samsun region. Thus it would be expected that the tobacco would cure much faster in the former region and that it probably cured faster during the 1937 season than during the 1938 season. If such were the case it is logical to attribute the variation in content of starch and sugars of these tobaccos, at least in part, to the difference in length of the period required for curing.

In the hot, dry Smyrna region the length of time in curing during which the tobaccos contained sufficient moisture to allow the starch to be converted to soluble sugars was relatively short; this resulted in a rapid and incomplete conversion of starch, as well as a short period of life in the green tissue during which the sugars could be lost by respiration. This would result in both higher starch and higher sugar contents, as found in the Smyrna tobaccos. The color of Smyrna tobaccos usually contains some green, which indicates rapid drying and an incomplete loss or conversion of chlorophyll.

In the Samsun region the climate is cooler and more moist. The period of curing is probably much longer, and the tobacco loses moisture more slowly. Consequently the period during which the conversion of starch to sugars can take place, and also the period during which the loss of sugar (by respiration) can occur, is longer. Therefore, it would be expected, as found, that a cured tobacco of less starch and sugar would result. In contrast to the Smyrna tobaccos, the Samsun tobaccos, which are usually some shade of brown or red, contain no traces of green.

The total reducing substances were determined and the polyphenols calculated by obtaining the difference between the total reducing substances and reducing sugars. The polyphenol coefficient (*22*), in grams of polyphenol per 100 grams of total reducing substances, was calculated for each sample. The average values are given in Table IV. Smuck (*22*) claims that the polyphenol content is related to flavor and aroma, and the polyphenol coefficient is related to color and quality; the greater the polyphenol content the better the flavor and the greater the aromatic properties; and the higher the polyphenol coefficient the darker the color.

The polyphenol content of the tobaccos studied here is least in the Samsun tobaccos and greatest in the Smyrna and Eastern Greek tobaccos. Among the grades the polyphenol content is largest in grade 1 and least in grade 3. The polyphenol coefficient is highest in the Samsun tobaccos which were darkest and least in the Smyrna tobaccos which were the lightest in color.

Total acidity content, expressed in terms of cc. of 0.1 *N* alkali required to neutralize the acid in 1 gram of tobacco, is, on the average, just the reverse of the alcohol extract and sugars in relative magnitude (Figure 3). The Samsun tobaccos are lowest in extract and sugar content and highest in acids, whereas the Smyrna tobaccos are highest in extract and sugar content and lowest in acids. This relation in connection with flue-cured tobaccos has been pointed out previously (*7, 8*). The work of Richards (*20*) would indicate that organic acids are by-products of respiration as carbohydrates are broken down. If this be true, a part of the increased acid content of the Samsun tobaccos may be due to this process which results in a decreased sugar content.

The average acid content of tobacco of grades 1 and 2 is less than that of grade 3 (Figure 4). This agrees with the observation of Piatnitski (*17, 18*) who worked with Russian tobaccos of the aromatic type. He concluded that the content of organic acids bears an inverse relation to quality as judged in tobacco classification.

The acid content of the tobacco from each of the areas of the Samsun region is essentially the same. This is true also for each of the areas of the Smyrna region. In the Eastern Greek region the same geographical division that seems to be correlated with differences in nitrogenous and sugar constituents holds, those tobaccos grown in the western part of the region being higher in acids than those grown in the eastern part.

The hydrogen ion concentration is expressed as pH. The average pH value is largest for Smyrna tobaccos and least for the Eastern Greek tobaccos. It is less for the tobaccos in grades 1 and 2 than it is for those of grade 3. This agrees with the ob-

FIGURE NO. 4

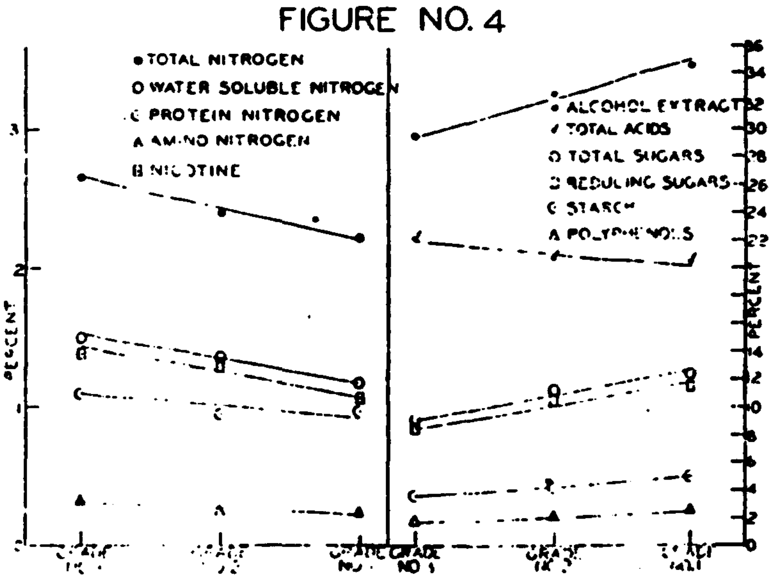

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TABLE IV. AVERAGE PERCENTAGE[a,b] ANALYSIS OF GREEK AND TURKISH TOBACCO OF 1937 AND 1938 CROPS

Region or Grade	Area, Grade, or Year	Total N	Protein N	Water-Sol. N	Total N as Protein N	Amino N	Nicotine	Petroleum Ether Extract	Alcohol Extract	Starch	Reducing Sugar	Total Sugar	Total Reducing Substances	Polyphenols
Samsun	Djannik	2.71	1.11	1.81	40.95	0.388	0.79	4.73	27.87	3.04	5.13	5.81	6.91	1.78
	Bafra	2.92	1.06	1.77	35.96	0.413	1.40	4.99	29.75	2.87	4.96	5.50	6.51	1.57
	Maden	2.94	1.09	1.72	37.07	0.421	1.40	5.27	30.55	2.81	4.91	5.50	6.75	1.84
	Evkaf	3.00	1.06	1.79	35.33	0.422	1.55	5.53	29.58	2.69	4.63	5.11	6.27	1.65
	Grade 1	2.76	1.03	1.59	37.32	0.376	1.16	4.74	31.22	3.14	5.38	6.13	7.24	1.87
	Grade 2	2.78	1.00	1.68	35.97	0.380	1.36	5.55	29.21	2.81	5.13	5.73	6.87	1.75
	Grade 3	3.14	1.21	1.83	38.54	0.480	1.34	5.10	27.88	2.62	4.22	4.38	5.72	1.51
	Average	2.89	1.08	1.70	37.33	0.412	1.29	5.13	29.44	2.86	4.91	5.48	6.61	1.71
Smyrna	Mugla	1.61	0.85	0.74	52.80	0.118	0.78	5.23	34.60	7.36	14.30	15.03	16.45	2.15
	Akhisar	1.61	0.84	0.77	52.17	0.129	0.91	5.13	35.94	7.01	14.06	15.00	16.51	2.45
	Foca	1.72	0.87	0.81	50.58	0.116	1.06	5.96	34.25	6.71	13.94	14.84	16.02	2.09
	Izmir	1.77	0.90	0.87	50.85	0.129	1.08	5.30	36.20	6.18	14.07	14.79	16.37	2.31
	Grade 1	1.57	0.84	0.72	53.50	0.113	0.85	4.81	37.01	7.48	14.87	15.45	17.32	2.46
	Grade 2	1.62	0.81	0.80	50.00	0.121	0.95	5.70	36.08	6.89	14.96	15.96	17.21	2.26
	Grade 3	1.84	0.95	0.88	51.63	0.137	1.07	5.71	32.72	6.13	12.45	13.33	14.48	2.01
	Average	1.68	0.87	0.80	51.79	0.124	0.96	5.41	35.25	6.83	14.09	14.91	16.34	2.25
Eastern Greece	Serres	2.68	0.97	1.61	36.19	0.305	2.00	6.53	28.78	2.83	7.71	8.38	9.51	1.80
	Drama	2.68	1.05	1.54	39.18	0.280	1.92	6.97	28.92	2.67	7.20	7.81	9.07	1.87
	Zihna	2.49	0.96	1.40	38.55	0.290	1.38	5.98	31.92	3.08	10.38	11.19	12.62	2.24
	Pravi	2.78	1.16	1.48	41.73	0.262	1.35	6.20	32.48	3.80	10.73	11.55	13.17	2.44
	Prossotsian	2.53	0.97	1.46	38.34	0.273	1.29	6.29	30.81	3.18	10.60	11.44	12.70	2.10
	Djebel	2.41	1.02	1.29	42.32	0.242	0.83	4.98	34.24	5.19	13.80	14.48	16.03	2.23
	Souyalassi	2.38	1.02	1.27	42.86	0.241	0.69	4.97	36.14	4.52	15.07	15.79	17.94	2.87
	Komatini	2.38	1.01	1.28	42.44	0.253	1.09	6.06	33.04	4.44	12.10	12.69	14.25	2.14
	Xanthi (Yaca)	2.96	1.15	1.70	38.85	0.319	1.55	7.24	31.07	3.26	8.05	8.45	10.44	2.39
	Grade 1	2.33	1.02	1.30	43.78	0.216	1.05	5.11	34.90	4.71	12.89	13.71	15.61	2.72
	Grade 2	2.59	0.99	1.51	38.22	0.264	1.47	6.84	31.91	3.45	10.48	11.27	12.84	2.36
	Grade 3	2.86	1.10	1.62	36.59	0.338	1.51	6.48	28.99	2.72	8.41	8.93	10.12	1.71
	Average	2.59	1.04	1.44	40.15	0.273	1.34	6.14	31.93	3.63	10.59	11.30	12.84	2.27
Western Greece	Agrinion	2.13	0.98	1.15	43.66	0.200	1.31	6.15	34.18	4.36	11.24	12.25	13.46	2.23
	Grade 1	2.08	0.88	1.08	43.35	0.197	1.31	4.91	37.40	4.78	11.26	12.10	13.87	2.61
	Grade 2	2.06	0.90	1.13	43.69	0.196	1.13	6.77	33.06	4.16	12.14	13.50	14.37	2.24
	Grade 3	2.31	1.01	1.23	43.73	0.204	1.50	6.77	31.40	4.15	10.32	11.16	12.15	1.84
Grade 1	1937	2.21	0.98	1.10	44.34	0.227	1.08	5.53	35.07	5.25	11.17	11.74	13.69	2.42
Grade 1	1938	2.26	0.97	1.18	42.92	0.227	1.02	4.39	34.30	4.74	11.85	12.74	14.32	2.47
	Average	2.24	0.98	1.17	43.63	0.227	1.04	4.96	34.69	5.00	11.51	12.24	13.96	2.45
Grade 2	1937	2.34	0.96	1.38	40.00	0.284	1.32	6.41	32.32	4.71	10.48	11.05	12.35	1.87
Grade 2	1938	2.48	0.94	1.38	37.90	0.252	1.29	6.13	32.43	3.67	10.48	11.36	12.86	2.38
	Average	2.41	0.95	1.38	39.42	0.253	1.31	6.27	32.38	4.19	10.48	11.21	12.61	2.13
Grade 3	1937	2.61	1.07	1.46	41.00	0.316	1.36	6.13	29.80	4.00	8.27	8.82	9.90	1.63
Grade 3	1938	2.70	1.10	1.52	40.74	0.318	1.40	5.89	29.77	3.25	8.60	9.26	10.37	1.68
	Average	2.66	1.09	1.49	40.87	0.317	1.38	6.01	29.79	3.63	8.46	9.04	10.14	1.66
Average 1937 crop		2.39	1.00	1.32	41.84	0.298	1.28	6.08	32.40	4.65	9.96	10.56	11.95	2.00
Average 1938 crop		2.45	1.01	1.36	41.06	0.296	1.34	5.47	32.17	3.89	10.32	11.12	12.56	2.25
Grand Average		2.43	1.00	1.34	41.45	0.296	1.34	5.78	32.28	4.27	10.14	10.84	12.26	2.13

Region or Grade	Area, Grade, or Year	Starch + Total Sugar	Total Acids[a]	H Ion Concn. (pH)[b]	Hygroscopicity	Sol. Ash	SiO_2	CaO	MgO	K_2O	Fe_2O_3 + Al_2O_3	P_2O_5	Cl_2	S	Polyphenol Coefficient
Samsun	Djannik	9.19	23.27	4.98	14.46	14.86	1.35	4.14	1.09	4.19	0.69	0.81	0.66	0.30	25.75
	Bafra	8.71	24.07	4.85	14.19	13.58	1.29	4.29	1.01	3.75	0.50	0.74	0.59	0.43	21.16
	Maden	8.63	23.55	4.87	14.08	13.47	1.36	4.30	1.20	3.71	0.70	0.76	0.67	0.40	27.26
	Evkaf	8.11	24.23	4.88	13.43	13.62	1.46	4.44	1.06	3.74	0.74	0.72	0.60	0.43	26.32
	Grade 1	9.62	23.80	4.85	14.26	12.84	1.48	3.93	1.00	3.87	0.63	0.71	0.62	0.42	25.83
	Grade 2	8.87	24.07	4.90	14.01	14.19	1.18	4.27	1.08	3.86	0.59	0.60	0.52	0.39	25.47
	Grade 3	7.49	23.48	4.94	13.82	14.63	1.44	4.53	1.21	3.80	0.75	0.70	0.75	0.41	26.40
	Average	8.66	23.78	4.90	14.03	13.89	1.37	4.24	1.10	3.85	0.66	0.76	0.63	0.41	25.87
Smyrna	Mugla	23.20	18.35	5.05	13.39	12.99	2.33	4.45	0.77	2.43	1.03	0.55	0.65	0.31	13.07
	Akhisar	22.79	19.30	5.12	13.92	12.82	2.43	4.42	0.92	2.98	0.95	0.56	0.31	0.34	14.84
	Foca	22.30	18.48	4.95	13.80	12.45	2.04	3.98	0.87	2.86	0.74	0.51	0.86	0.38	13.05
	Izmir	21.66	18.43	5.04	13.77	12.48	1.80	4.53	0.81	2.48	0.91	0.50	0.77	0.35	14.11
	Grade 1	23.76	18.04	5.09	14.00	12.10	2.53	3.98	0.80	2.68	0.90	0.50	0.69	0.37	11.20
	Grade 2	23.61	18.26	5.01	13.93	12.48	1.80	4.24	0.75	2.77	0.92	0.55	0.55	0.32	13.13
	Grade 3	20.14	19.63	5.01	13.23	13.48	2.09	4.82	0.99	2.61	1.00	0.54	0.72	0.35	13.68
	Average	22.50	18.64	5.04	13.72	12.69	2.14	4.38	0.85	2.69	0.91	0.53	0.65	0.35	13.77
Eastern Greece	Serres	11.52	23.29	4.90	13.20	13.81	1.49	5.69	0.89	2.50	0.61	0.55	0.77	0.43	18.93
	Drama	10.77	22.95	4.82	13.76	12.98	1.32	5.18	0.90	2.39	0.72	0.66	0.91	0.38	20.62
	Zihna	14.62	23.65	4.89	14.26	12.63	1.21	5.52	0.71	2.40	0.54	0.54	0.60	0.45	17.75
	Pravi	15.76	21.25	4.66	13.90	11.12	1.17	3.98	0.93	2.74	0.56	0.69	0.83	0.39	18.53
	Prossotsian	14.97	22.67	4.75	15.25	13.55	0.95	5.23	0.83	2.67	0.69	0.56	0.50	0.43	16.54
	Djebel	20.23	18.64	4.70	15.04	11.72	1.15	3.53	0.88	3.02	0.55	0.66	0.75	0.48	13.91
	Souyalassi	20.81	17.49	4.63	15.65	11.30	1.00	3.25	0.79	2.78	0.53	0.68	0.71	0.43	16.00
	Komatini	17.62	19.80	4.72	15.50	12.42	1.45	4.00	0.98	2.75	0.68	0.64	0.93	0.40	15.02
	Xanthi (Yaca)	12.07	21.14	4.73	14.76	13.10	1.40	4.67	1.04	2.95	0.75	0.58	1.12	0.40	22.89
	Grade 1	18.95	19.94	4.72	14.28	11.08	1.53	4.24	0.83	2.47	0.65	0.62	0.83	0.42	17.43
	Grade 2	15.10	20.82	4.73	14.78	12.48	1.03	4.43	0.85	2.75	0.61	0.63	0.72	0.42	18.38
	Grade 3	11.95	22.98	4.86	14.81	14.05	1.18	5.01	0.97	2.91	0.68	0.61	0.82	0.44	16.90
	Average	15.33	21.25	4.77	14.62	12.54	1.25	4.56	0.88	2.71	0.65	0.62	0.79	0.43	17.65
Western Greece	Agrinion	17.00	20.05	4.92	15.71	13.69	1.04	4.43	0.73	3.17	0.54	0.51	0.82	0.45	16.57
	Grade 1	17.41	20.80	4.94	15.00	13.36	0.90	4.61	0.69	3.40	0.52	0.82	0.88	0.50	18.92
	Grade 2	18.12	18.37	4.87	16.51	13.69	1.00	4.08	0.71	3.05	0.45	0.52	0.78	0.42	13.69
	Grade 3	15.78	21.20	4.95	15.61	14.01	1.22	4.60	0.78	3.07	0.65	0.48	0.81	0.43	15.14
Grade 1	1937	17.87	20.22	4.84	14.67	11.68	1.89	4.05	0.84	2.73	0.80	0.60	0.82	0.43	17.81
Grade 1	1938	18.11	20.59	4.83	13.83	11.96	1.58	4.16	0.86	3.04	0.78	0.61	0.70	0.39	17.25
	Average	17.80	20.41	4.83	14.25	11.82	1.74	4.11	0.85	2.89	0.70	0.61	0.76	0.41	17.55
Grade 2	1937	16.28	20.33	4.82	14.49	12.42	1.07	4.28	0.82	3.08	0.65	0.67	0.65	0.38	15.14
Grade 2	1938	15.45	21.18	4.84	14.43	13.35	1.42	4.34	0.92	2.97	0.63	0.63	0.65	0.39	18.51
	Average	15.80	20.76	4.83	14.46	12.89	1.25	4.31	0.87	3.03	0.64	0.65	0.65	0.39	16.89
Grade 3	1937	13.28	22.25	4.90	14.35	12.56	1.23	4.81	1.00	3.07	0.78	0.64	0.79	0.41	16.46
Grade 3	1938	12.88	22.12	4.92	14.12	14.59	1.65	4.82	1.03	3.05	0.75	0.61	0.78	0.41	16.20
	Average	13.07	22.19	4.91	14.24	14.08	1.45	4.82	1.02	3.06	0.77	0.63	0.79	0.41	16.37
Average 1937 crop		15.72	20.94	4.86	14.50	12.50	1.41	4.38	0.89	2.96	0.70	0.64	0.75	0.40	16.74
Average 1938 crop		15.42	21.29	4.86	14.13	13.30	1.55	4.44	0.93	3.02	0.70	0.61	0.71	0.40	17.91
Grand Average		15.57	21.12	4.86	14.32	12.90	1.48	4.41	0.91	2.99	0.70	0.63	0.73	0.40	17.37

[a] Total acids expressed as cc. 0.1 N alkali required to neutralize the acid in 1 gram of tobacco.
[b] Since pH values are logarithmic and may not be averaged like ordinary numbers, the pH values were converted to moles per liter. These values were averaged, and the results were reconverted to pH units.

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servation of Pyriki (*19A*) that the better grades of Turkish tobacco have lower pH value than the poorer ades.

ASH AND MINERAL CONSTITUENTS. The work of Darkis and collaborators (*7, 8*) with flue-cured tobaccos shows that the mineral constituents in some tobaccos are localised in certain parts of the plant and that the water supply available to it affects the amount of ash constituents taken from the soil by the plant. The interpretations placed on the data for the mineral constituents in the following discussion are subject to error because of the absence of rainfall data, yield data, soil analyses, and analytical data for all parts of the plant.

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The total ash data obtained are included here in order to afford a complete picture of the mineral constituent of these tobaccos. In the absence of the complementary data on weather and soil an adequate interpretation of the significance of the mineral content of these tobaccos is not possible at this time. However, experiments are in progress wherein the nutrition of the plant is controlled and known and the whole of the plants produced is being subjected to analysis. Complete weather and soil data are available. When the complete data from these experiments become available it is believed that it will be possible to give at least a partial interpretation of the significance of the different trends in the mineral content of the tobaccos of the various types discussed in this paper.

The following condensed figures show the wide range over which mineral constituents vary: soluble ash 9.30 to 16.74, silica 0.47 to 3.12, calcium oxide 2.74 to 6.37, magnesium oxide 0.61 to 1.26, potassium oxide 1.96 to 5.00, Fe_2O_3 + Al_2O_3 0.34 to 1.37, P_2O_5 0.44 to 0.96, chlorine 0.15 to 1.34, and sulfur 0.25 to 0.58%.

The average ash content as well as the average content of silica, calcium, magnesium, and potassium is slightly greater in the tobacco of the 1938 crop than in that of the 1937 crop. This would probably be expected (*7, 8*) if the 1937 season was dryer than the 1938 season, as suggested.

The average content of soluble ash, magnesium, and potassium is somewhat higher in the tobaccos from the Samsun region than it is in those from the Smyrna and Greek regions. The average silica content is highest in those tobaccos grown in the Smyrna region, the average calcium content highest in the Greek tobaccos. The higher calcium content of the latter may be due to the high calcium content of the soils on which the tobacco was grown. The soils of Macedonia originate from the limestone formations of which the Rhodope mountains are composed (*15*).

The calcium contents of the tobaccos of each area in the Samsun region are about equal. This same relation holds for the tobaccos of each area in the Smyrna region; this indicates that soils of areas within each region have about an equivalent content of available calcium. The calcium content of the tobaccos from the different areas of the Eastern Greek region is quite variable and seems not to be correlated directly with geographical locations. It probably reflects, however, the content of available calcium in the soil of each area.

The average content of potassium in the tobacco varies rather widely among the areas within each region as well as among the regions. This is typical of the potassium content of tobaccos (*7, 8*). The generally increased potassium content of the Samsun tobaccos, however, would indicate a larger content of available potassium in the soils of that region.

The generally increased ash content of the tobaccos from the Samsun region is probably due, in part, to the increased loss of carbohydrate during the curing of these tobaccos, which in turn would give an apparent increase in content of mineral materials.

The tobaccos of grade 1 are lowest and those of grade 3 highest in average soluble ash, calcium, magnesium, and potassium content. These differences in relation to grade would be expected to follow this pattern because of the increased percentage of carbohydrate materials in the tobaccos of better grade.

In general the content of iron and aluminum in most of these tobaccos is high (*8*), that of the tobaccos from the Smyrna region being the highest. This would indicate that the soils used for the production of these tobaccos were high in available iron or aluminum. Many of these soils are red (*15*), a color indicating a high iron content.

The phosphorus content of the Samsun tobaccos is greatest, and that of the Smyrna tobaccos smallest. In general, the phosphorus content tends to be low; this would indicate soils of low available phosphorus content.

The average content of chlorine is high. This would be expected because of the fact that the soils on which the tobaccos are generally grown are fertilised by excrement of sheep and goats, which furnishes considerable chlorine to the soil.

The average sulfur content of these tobaccos is low (*8*). As the plant will take up much more sulfur than these tobaccos contain, it is logical to assume that the content of sulfur is low in the soils on which the tobaccos were grown. Little sulfur is added to the soil by the excrement of the sheep and goats.

The hygroscopicity, or the ability of a tobacco to take up water, is of importance in determining the suitability of a tobacco for blending purposes. Therefore, the amount of water that these tobaccos would take up in an atmosphere of 72% relative humidity, after being dried over concentrated sulfuric acid, was determined. This is purely an empirical procedure which gives relative results only. These vary from 12.21 to 17.73% for the acid-dried tobacco. The hygroscopicity does not seem to be directly correlated with any one or any specific group of the chemical constituents determined.

In the foregoing discussion it has been assumed that these tobaccos did not possess characteristics of any innate nature that would cause the plants from each region and area to develop according to different physiological patterns, in respect to the final chemical make-up of their physical structure. If such is the case.

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the assumption could probably be made that seed of tobacco from each area and region, if planted in the same locality, grown, and cured under similar conditions, should give a product rather similar in chemical composition to that of each of the others.

Incomplete and inconclusive unpublished work of the writers indicates that characteristics of an innate nature do exist between Samsun and Smyrna tobaccos. If such is the case these characteristics probably originated as a result of the selection of natural crosses by the growers during the period, since tobacco was first introduced into Turkey shortly after the discovery of America.

The presence of innate characteristics may cast much doubt on the validity of any of the theoretical speculations offered. They do not, however, change the fact that differences among the chemical compositions of these tobaccos exist. Therefore, the practice of the trade in attempting to get tobaccos of each type to blend in making blended products is justified.

The data presented here show that the tobaccos of the Turkish type may vary within wide limits in chemical make-up and that the tobacco from any area may not be of constant chemical composition from year to year. It also shows that the tobaccos of a given main region tend to be dissimilar in chemical composition from those from other regions. The similar data obtained for the 1937 and 1938 crops, when the analyses of all samples of the specific crops are averaged, indicate that an experienced tobacco blender could maintain a blend of rather constant chemical composition, if a sufficient supply of tobacco from several crops from many areas of the different regions was available.

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