

and compositions of the mixed alums are deduced from the linear law of densities for isomorphic crystals.

In the literature, values of C_{11} , C_{12} , and C_{13} are available from Voigt's¹ work on potassium alum; and in the above units they are respectively 2.43, 1.009, and 0.843, comparing well with the results of the present investigation.

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1. Voigt, W., *Göttinger Nachrichten*, 1918-19 Heft, I, 85.

BLOOD GROUPS OF PUNJABIES AND MALDIVIANS

OPPORTUNITY was afforded during the war to examine the blood groups of 2,500 Punjabies at the I.M.H., Rawalpindi, and of 211 Maldivians at Addu Atoll.

This Atoll is the southernmost of the Maldivian group of islands and the inhabitants are Singhalese in origin. A considerable inbreeding has been going on for a few centuries and the total population is less than 2,000. Therefore 211 persons were considered to be fairly representative random sample.

Vincent's technique was followed to determine the groups. The frequency distribution of different groups was as follows:—

	O	A	B	AB	A/B ratio
Punjabies	34.8	21.5	33.3	7.4	0.7
Maldivians	58.3	17.5	21.8	2.4	0.8

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TURBIDITY TEMPERATURE OF OILS AS DETERMINED BY BELLIER'S TEST AND ITS SIGNIFICANCE AS AN ANALYTICAL CONSTANT

The solubility of oils in various solvents is a constant, depending on the nature of the glycerides composing the oil. In the Valenta test, acetic acid is used as a solvent. Fryer and Weston¹ found that a mixture of equal volumes of 92 per cent. ethyl alcohol and pure amyl alcohol can also be satisfactorily employed as a solvent for turbidity value. This turbidity value is the temperature at which the solution of oil in the solvent shows the first signs of turbidity on cooling.

There are two factors which, if not allowed for, entirely destroy the reliability of the estimation of solubility in the solvents. One is free fatty acids which lower the turbidity temperature, increasing the solubility of the oils.

The other is moisture, which raises the turbidity temperature, decreasing the solubility. In the Valenta test preliminary operations, viz., standardization of the solvents, preparation of oils, corrections for free acidity, moisture and acetic acid, etc., have, therefore, to be carried out.

In the case of soap and commercial fatty acid analysis the original glycerides are not available and, therefore, Fryer and Weston² investigated the turbidity temperatures obtained with the mixed fatty acids themselves with various solvents and proposed acetic acid of 90 per cent. strength as the most suitable solvent for the purpose and standardized as in the test for oils against pure oleic acid. The presence of small amounts of undecomposed glycerides in the mixed fatty acids raises the turbidity temperature considerably; it is, therefore, essential that a complete saponification is obtained before the test is made, and the mixed fatty acids from soap or as obtained commercially, should preferably be re-saponified by alcoholic potash. These authors have suggested that in addition to its value in the analysis of soap and of commercial fatty acids, the test may be applied to oil analysis. It has the advantage that no correction for acidity is necessary as in the case of oils. A further advantage offered by this method is that the result is not influenced by the presence of moisture in the oil or in the acid as in the case of the turbidity test with the oil (Valenta test).

The turbidity temperature as determined by Bellier's test is also based on the solubility factor of the mixed fatty acids of the oils in 70 per cent. alcohol under prescribed conditions and is characteristic of a particular oil. The test was subsequently modified by Mansfeld, Alder and Franz and examined by Evers³ who found the modification satisfactory. Fryer and Weston also confirmed this in their own experience and has described it in their *Technical Handbook of Oils, Fats and Waxes* (Vol. II, p. 140). This modified test has been used by the writer for judging the purity of oils and has been found simple, rapid and fairly accurate for routine analysis as compared to the Valenta test. The results are not affected by the presence of moisture in the oil and no corrections for free acidity, etc., are required as in the Valenta test. Moreover, it can be conveniently used in the analysis of soap and commercial fatty acids and also for determining the percentages of two mixed oils, if the range between the turbidity temperatures of these two oils is fairly wide, e.g., groundnut oil and sesame oil, almond oil and sesame oil, etc. Other workers⁴ have also successfully used the same test for determining adulteration of groundnut oil in some edible oils and also suggested its analytical importance. Besides, the turbidity temperatures obtained with fatty acids by the method of Fryer and Weston are different from those for the respective oils, depending on the difference in the solubility of the glycerides of the oil and its fatty acids in the same solvent. If the Bellier's test is employed for the same purpose, the turbidity temperatures obtained with oils and their mixed fatty acids are nearly identical as the

glycerine that is split up from the glyceride has been found to exert no appreciable effect on the turbidity temperature. This is evident from the identical turbidity temperatures of fatty acids and glycerine (as in the case of oil) and prepared fatty acids alone (fatty acids prepared from the respective oils, *vide* Table III). Again, uniformity of solvent, *viz.*, 70 per cent. alcohol, is maintained as regards analysis of oils, soaps and fatty acids. In the Bellier's test 1 c.c. of commercial acids or those split up from soap is boiled with alcoholic potash, treated with acetic acid and the turbidity temperature is then determined. This treatment with potash in the test itself has the advantage that it ensures complete saponification of the unchanged glycerides, if any, present in the soap; and, therefore, separate treatment with potash is not necessary as in the case of Fryer and Weston method for fatty acids and soap analysis as mentioned above.

Turbidity temperatures of some common oils and fatty acids split up from oils have been observed for a number of samples of the same oil. This temperature has been found to be nearly constant for an oil. However, after examining a large number of commercial oils, it has been found that it varies within two degrees for some of the samples of the same oil. But it is more specific than other analytical constants, such as saponification value, iodine value, etc., which have a comparatively wide range. Turbidity temperatures as recorded by other workers differ; but the difference is likely due to variations in the composition of different mixed fatty acids in oils of different climatic regions. The margin of difference, however, is not so great as in the case of other analytical constants.

TABLE I
Turbidity Temperatures and Butyro-Refractometer Readings

Oil	T.T. in °C.	B.R.R. at 40°C.
Almond	1-2	57.0
Olive	13-14	55.4
Coconut	12-13	35.5
Safflower	12-14	66.0
Nigerseed	22.5-25	63.0
Rape	22	59.5
Cotton-seed	21	58.5
Castor	-5.0	69.0
Maize	21.0	59.5
Arachis	38-38.5	55.5

The turbidity temperature together with B.R. reading enables the chemist to judge fairly easily the purity of the oil. In the case of almond oil which is rather costly, the adulteration with olive, sesame or arachis oil can be readily detected and even ascertained as 5 to 10 per cent. of any of the adulterants raises its turbidity temperature by 6°-15° C.

The turbidity temperatures of oils and the corresponding mixed fatty acids split up from

these oils and also turbidity temperatures of mixtures of two oils and the corresponding fatty acids prepared separately from these mixtures are nearly identical; as it has been found that the presence or absence of glycerine in the test has practically no effect on the turbidity temperature, which is, therefore, characteristic of free fatty acids present in the solution.

TABLE II

Oil	T.T.
Almond ..	1-2
.. + 5% Olive ..	6.0
.. + 10% " ..	8.0
.. + 5% Sesame ..	6.5
.. + 10% " ..	8.5
.. + 5% Arachis ..	11.0
.. + 10% " ..	15.0

TABLE III

Oils	T.T. of oils	T.T. of fatty acids
Groundnut	38-38.5	38.5
Sesame	15-16	16.5
Coconut	12-13	13.0
Almond	1-2	1.0
Olive	13-14	14.0
Groundnut 50% } Sesame " } Groundnut 30% }	.. 30.5	30.5
Sesame 70% } Groundnut 50% }	.. 24.5	24.0
Coconut " } Groundnut 80% }	.. 30.5	30.5
Coconut 20% } Groundnut 50% }	.. 36.5	36.0
Almond " } Groundnut 50% }	.. 30.5	30.0
Olive " }	.. 30.0	31.0

When the test is employed for a mixture of two oils the turbidity temperature of the mixture will be predominantly influenced by the oil which has a higher turbidity temperature. This is evident in the case of groundnut oil when it is adulterated with other oils such as almond, olive, sesame, nigerseed, coconut, safflower, etc. A series of experiments were carried out by taking pure samples of the above oils and mixing them with pure groundnut oil in definite percentages and determining the turbidity temperatures of the corresponding mixtures. These results have been tabulated below with the B.R. reading of pure oils.

A chart of the above results, if plotted, enables the analyst to determine the percentage of adulteration with groundnut oil in various oils nearly accurately. The procedure can be conveniently followed in the case of other oils by plotting such charts of turbidity tempera-

TABLE IV

A		B				
Per cent. of Groundnut oil B. R. Reading .. 55-5		Turbidity temperature of the oil mixture containing the percentage of groundnut oil shown in column A and the oil mentioned below to make up the balance				
T.T.		Coconut BR. 35-5	Niger seed BRR. 63-0	Safflower BRR. 66-0	Almond BR. 57-0	Olive B. R. R. 55-4
Pure oil, 38—38-5		12—13	22-5—25	12—14	1—2	13—14
Gr. 10%		16-0	26-0	18-5	15-0	17-5
" 20%		21-0	28-0	22-5	20-0	21-0
" 30%		21-0	29-5	27-0	25-0	24-0
" 40%		27-5	31-0	32-0	28-0	27-0
" 50%		30-5	32-5	32-0	30-5	30-0
" 60%		32-5	34-0	33-5	32-5	32-0
" 70%		34-5	35-5	35-0	34-5	34-0
" 80%		36-5	36-5	36-5	36-0	36-0
" 90%		37-5	37-5	37-5	37-5	37-5

tures of any two oils mixed in definite proportion.

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tubes were no more viable. For these trials the following fungi were used:

1. Fryer and Weston, *Analyst*, 1918, 43, 4-20.
2. —, *Technical Handbook of Oils, Fats and Waxes*, 2, 302-303.
3. Evers, *Analyst*, 1912, 37, 487.
4. Hawley, H. *Curr. Sci.*, 1937, 640; Desai, C. M., and Patel, A. H., *Ibid.*, 1945, 37, 130; Narayanier, S., *Ibid.*, 1945, 177.

A METHOD OF SEALING TUBES OF FUNGAL CULTURES TO INCREASE THEIR LONGEVITY

MAINTENANCE of fungi on nutrient media involves frequent transfers, as the medium soon loses its water contents and becomes dry, especially under the dry and hot climatic conditions of Delhi. Several attempts were made to modify the standard method so as to check the quick-drying of the nutrient agar medium and thus to reduce the frequency of sub-culturing. It was realised that if the mouth of the culture tube were closed some other way than by the usual cotton-wool plug so that the hot and dry atmosphere of the room in which the cultures are stored did not affect the agar medium inside the tube it would remain moist for a longer period. A substitute was ultimately found in a combination of cellophane and paraffin wax. The fungi in culture tubes thus sealed have been found to remain viable for at least eight months (Fig. 3), and the transfers made grew true to type. The growth of the fungus in sealed tube was seen to have been checked but when at the end of eight months the seal was replaced by the usual sterilised cotton-wool plug the fungus resumed its growth. In parallel sets of cultures maintained in tubes either plugged with cotton-wool or sealed with cellophane the media had completely dried and had become brittle and membranous (Figs. 1, 2), the fungi in these



FIGS. 1-3. Cultures of *Polystictus hirsutus* (Wulf) Fr. subcultured on 19-3-46 on Potato Dextrose agar; photographed on 19-11-46.

FIG. 1. Culture tube plugged with cotton wool.

FIG. 2. Culture tube sealed with cellophane.

FIG. 3. Culture tube sealed with cellophane and paraffin wax.