

赤外線吸収スペクトルによる植物精油の分析

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植物精油の種類は極めて多く、これらの同一性の確認、或いは鑑定にはかなり精油一般に対する化学的知識と経験が必要である。

従来これらの分析は物理恒数の測定、主要成分の定性、定量によって行われてきたが同一品名のものについても原植物、産地、採油方法及び年度等の相異によってその性質が異なり、逆に品名の異なるものについてもその主成分が同一であるため、ほとんど同じ物理的性質を有するものがあるなどむずかしい問題がある。

近年、めざましい発展をとげた赤外線吸収スペクトルやガスクロマトグラフィーによる分析の報告も数多くあるが、主要精油全般についての総括的なものは報告されていないので、筆者は税表第3301号に特掲されているものを主体とした約30種類の精油について赤外線吸収スペクトルと物理恒数の測定を行なった。

1 試 料

本実験に使用した試料の大部分は高砂香料KKから提供されたものであり、一部輸入品の試料及び直接筆者が原植物から調製したものも使用した。

2 物理恒数の測定

2.1 比重測定

少量試料の比重測定には従来から多くの器具が考案されているが、約1mlの試料について迅速に精度よく測定でき、しかも測定に使用した試料を精度よく回収するには満足すべき装置がなかったので、筆者の考案した"メスシリンドー比重計"によって測定した。

2.2 屈折率測定

アッペ屈折計を使用し20°で測定した。

2.3 旋光度測定

Schmidt Haensel 旋光計及びRudolph 旋光計を使用した。

着色の著しい試料については一部測定不可能なものがあった。

物理恒数の測定結果はTable 1の通りである。

Table 1 Physical Constants of Essential Oils

Spec.t. No.	Sample No.	Name	Origin, Maker	S.G. 4	t 20 n D	[a] t D
1	4	Abies oil	—	0 9554	20°C 1 4750	-30° 10°C
2	46	—	—	0 8972	20°C 1 4695	-31° 15°C
3	55	Anise oil	—	0 9930	15°C 1 5550	-0 12°C
4	11	Bay leaf oil	*	0 9774	19°C 1 5125	—

Spect.	Sample No.	Name	Origin, Maker	S.G. 4	n_{D}^{20}	$[\alpha]_D^t$
5	12	Bergamot oil	Bush, England	0 8866 19°C	1 4625	+30 ⁰ ₁₀ C
6	39	Bois de rose oil	—	0 8735 22°C	1 4595	-3 ⁴ ₁₀ C
7	13	Cananga oil	Naarden, Java	0 9140 19°C	1 4950	-21 ² ₁₀ C
8	16	Cederwood oil	M M R	0 9563 19°C	1 4995	-34 ⁹ ₁₃ C
9	14	Cinnamon bark oil	—	1 0340 19°C	1 5900	-0 ⁹⁷ ₁₀ C
10	15	Cinnamon leaf oil	—	1 0756 19°C	1 5425	—
11	17	Citronella oil	—	0 8869 19°C	1 4640	-4 ⁸ ₁₃ C
12	18	Clove oil	—	1 0473 19°C	1 5295	—
13	54	Eucalyptus oil	Spain	0 9308 15°C	1 4600	+4 ⁵ ₁₂ C
14	19	—, —	—	0 9423 19°C	1 4575	+1 ⁷ ₁₃ C
15	53	Eucalyptus citriodora oil	Brazil	0 8669 15°C	1 4475	+1 ² ₁₂ C
16	20	Fennel oil	—	0 9645 19°C	1 5470	+7 ⁶ ₁₃ C
17	31	Geranium oil	Burbon	0 8944 19°C	1 4620	-11 ³ ₁₃ C
18	35	Ho wood oil	—	0 8771 22°C	1 4615	-16 ⁸ ₁₃ C
19	38	Jasmin oil	P. Rovertet, France	0 9421 22°C	1 4860	—
20	45	—, —	G. Cupus, Italy	1 0083 20°C	1 4935	—
21	32	Lavender oil	P.R., France	0 8879 22°C	1 4570	-7 ⁰ ₁₄ C
22	21	Lemon oil	California, U.S.A.	0 8520 19°C	1 4700	+68 ⁶ ₁₃ C
23	33	Lemongrass oil	—	0 8951 22°C	1 4845	—
24	57	Mandarin orange oil	Sicily, Polak's Frutal	0 8545 15°C	1 4700	+100 ⁹ ₁₂ C
25	56	—, — (Commercial)	—, —	0 8512 15°C	1 4700	+103 ¹ ₁₂ C
26	22	Orange oil	Florida, U.S.A.	0 8464 19°C	1 4680	+114 ⁸ ₁₂ C
27	23	Palmarosa oil	S A S, Mero	0 8913 19°C	1 4720	+0 ⁶ ₁₂ C
28	34	Patchouli oil	Penag	0 9637 22°C	1 5045	—
29	37	Peppermint oil	—	0 9003 22°C	1 4580	-22 ⁸ ₁₃ C
30	24	Petitgrain oil	Paraguay	0 8934 19°C	1 4540	-4 ² ₁₂ C
31	5	Pine oil	—	0 8801 20°C	1 4700	-3 ⁶ ₁₅ C
32	41	—, —	Glidden, U.S.A.	—	—	—
33	42	—, —	—, —	0 9292 20°C	1 4780	+2 ² ₁₅ C
34	25	Rosemary oil	B.F	0 9096 19°C	1 4650	+4 ¹ ₁₂ C
35	26	Sandalwood oil	—	0 9746 19°C	1 5025	-17 ⁶ ₁₂ C
36	47	—, —	—	0 9896 20°C	1 5035	-18 ² ₁₅ C
37	6	—, —	J&E Sozio France	—	1 4980	—
38	3	—, —	mysore Essent. Co. India	—	—	—
39	36	Spearmint oil	—	0 9269 22°C	1 4845	-60 ³ ₁₃ C
40	27	Star anise oil	—	0 9867 19°C	1 5565	0
41	30	Shyo gyu oil	—	0 9355 19°C	1 4825	+16 ² ₁₃ C
42	58	Tangerine oil	Polak's Frutal	0 8568 15°C	1 4700	+85 ⁰ ₁₂ C
43	28	Thyme oil	—	0 9313 19°C	1 5010	-1 ³ ₁₃ C
44	29	Ylang ylang oil	—	0 9844 19°C	1 5155	-25 ⁵ ₁₃ C
45	50	Yuzu oil	Japan, Gifu	0 8500 15°C	1 4750	+89 ⁴ ₁₀ C

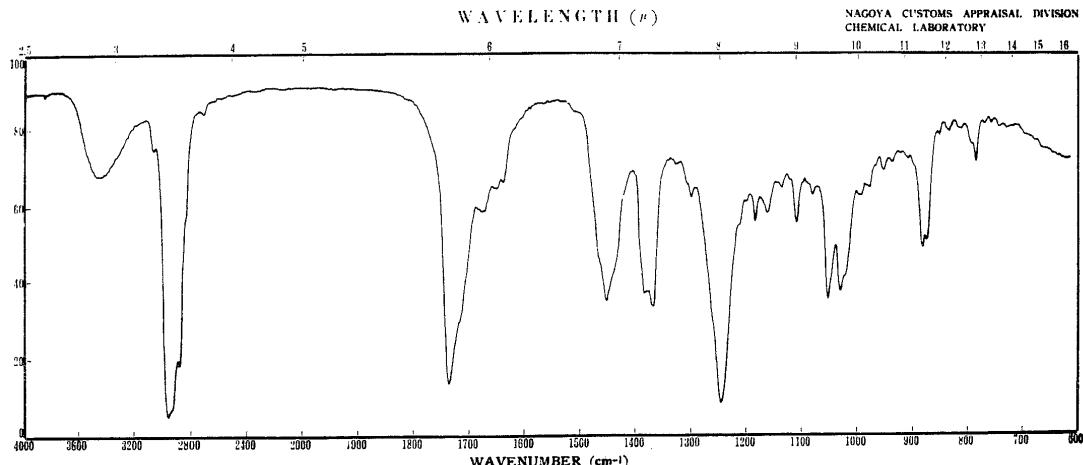
3 赤外線吸収スペクトルの測定

チャート作成には日本分光 IR-S 型分光器を使用し、波数測定には日本分光 DS-40 型分光器を使用した。

試料はいずれも液体であったので岩塩板による液膜法を採用し、恒温恒湿室で測定した。

吸収解説中、化合物とのカッコ内の数値は IRDC カード番号である。IRDC カードに収録されていなかった化合物は純品（ガスクロ的に単一化合物）を入手し、これらの赤外線吸収スペクトルによって吸収の帰属を検討した。

Table 1 に記載した 45 種類の試料の赤外線吸収スペクトルは Fig 1 ~ 45 のとおりである。

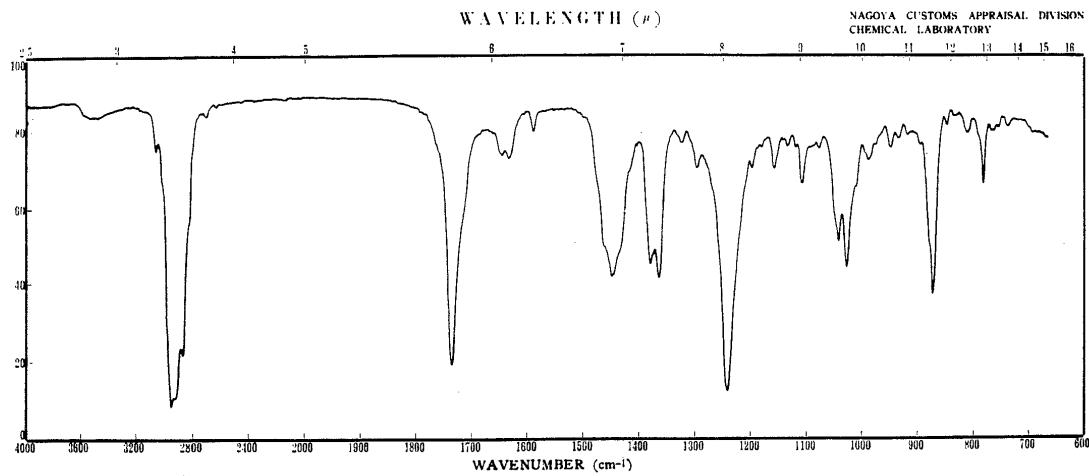


SPECTRUM NO.	SAMPLE NO. 4 Abies oil (Pine needle oil)	INSTRUMENT JASCO IR-S	ORIGIN MAKEK	$\text{SG}_{\text{D}}^{20} 0.9554^{\circ}\text{C}$ ($\alpha_{\text{D}}^{10} - 30.6^{\circ}\text{C}$) $n_{\text{D}}^{20} 1.4750$
DATE, Aug. 1964		STATE Liquid film		3490, 3075, 2950, 2920, 2870, 1740, 1734, 1714, 1680, 1663, 1647, 1454, 1384, 1366, 1300, 1245, 1187, 1164, 1140, 1110, 1055, 1032, 886, 878, 788.

Fig 1

主要吸収は Bornyl acetate によるもの。

886, 878 は Camphene および Pinene によるもの。

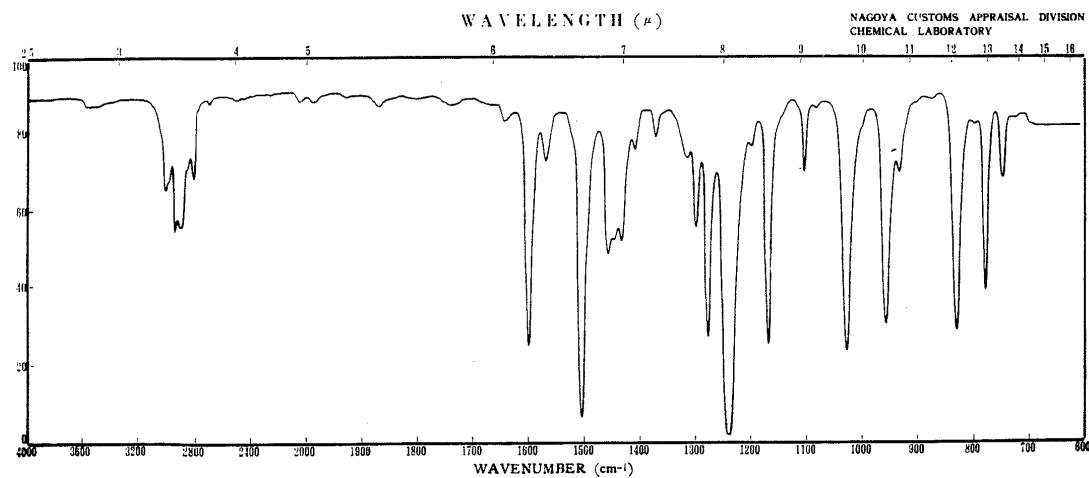


SPECTRUM NO.	SAMPLE NO. 46	INSTRUMENT JASCO IR-S	ORIGIN	SG 2_4 0 8972 [α] $^{15}_D$ -31 $^{10}_C$
DATE Mar.1965	Abies oil	STATE Liquid film	MAKER	n 2_4 1 4695

3490, 3075, 2950, 2920, 2875, 1740, 1647, 1598, 1454, 1384, 1366, 1300, 1245, 1164,
1113, 1048, 1032, 995, 955, 940, 886, 878, 788.

Fig 2

主要吸収は Bornyl acetate によるもの ,1598 ,1647(いずれも C=C),886 ,878 ,788 は Pinene, Camphene によるもの。

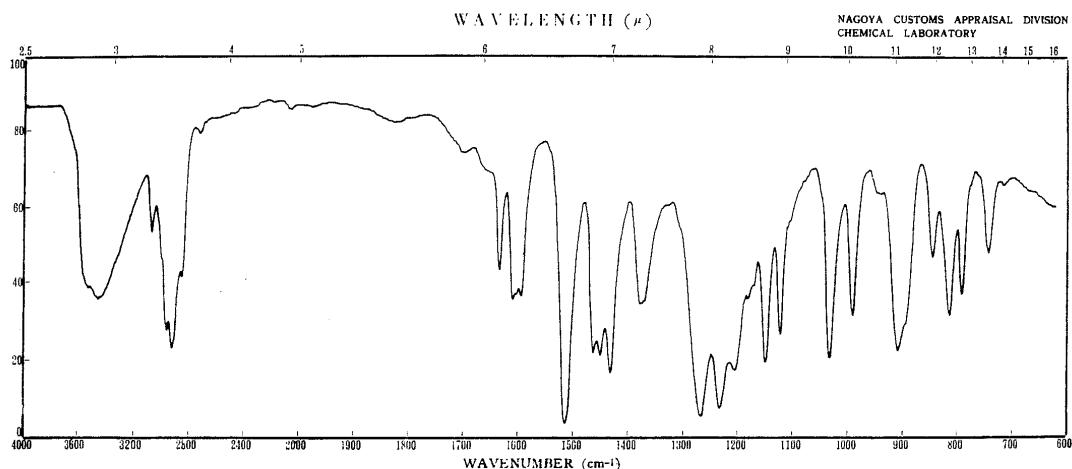


SPECTRUM No.	SAMPLE No. 55	INSTRUMENT JASCO IR-S	ORIGIN MAKER	SG $\frac{1}{4} 50$ 9930 $[\alpha]_D^{12}$ -0 $\frac{1}{4} 0$ n $\frac{2}{4} 0$ 5550
DATE Feb.1965	Anise oil	STATE Liquid film		

3022, 2952, 2929, 2912, 2828, 1655, 1608, 1576, 1510, 1466, 1450, 1440, 1418, 1378,
1324, 1306, 1290, 1253, 1208, 1175, 1112, 1036, 963, 942, 838, 792, 755.

Fig 3

主要吸収は Anethole (1438) によるもの。Staraniise oilとの区別は物理恒数、1R吸収スペクトルのみでは不可能。

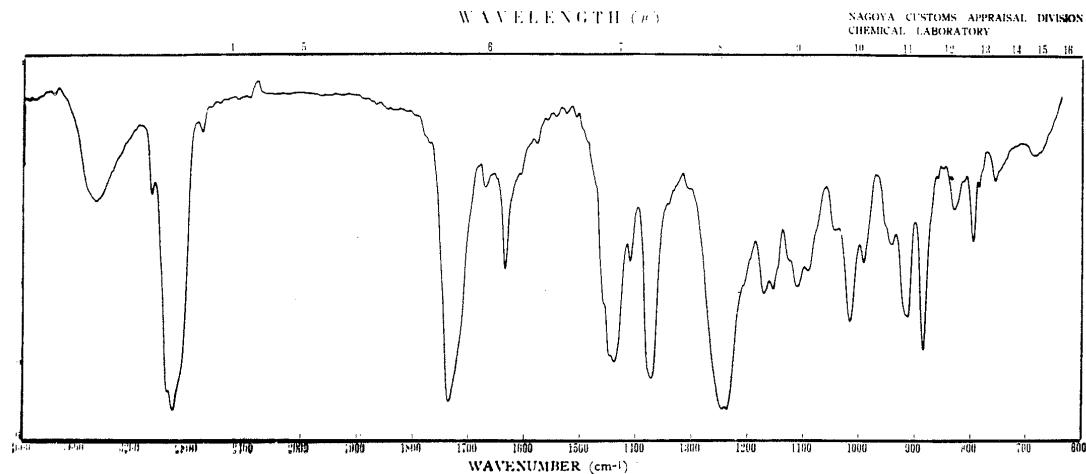


SPECTRUM No.	SAMPLE No. 11	INSTRUMENT JASCO IR-S	ORIGIN MAKER	SG $\frac{2}{4} 0$ 9774 $[\alpha]_D$ n $\frac{2}{4} 0$ 1 5125
DATE Sep.1964	Bay Leaf oil	STATE Liquid film		

3510, 3440, 3060, 2962, 2930, 2835, 1710, 1640, 1615, 1597, 1512, 1465, 1452, 1433,
1370, 1268, 1230, 1205, 1150, 1122, 1036, 914, 850, 817, 794, 747.

Fig 4

主要吸収は Eugenol によるもの。



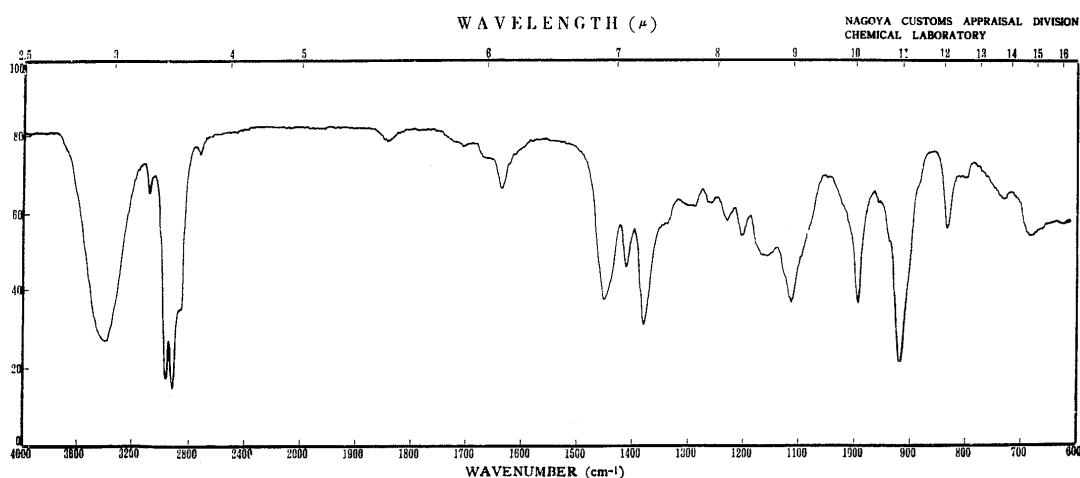
SPECTRUM #	SAMPLE # 12	INSTRUMENT JASCO IR-S	OKIGIN England MAKER Bush	$SG \frac{2}{4} 0 \frac{8866}{D} [\alpha] \frac{1}{D} + 30^{\circ}$
DATE Sep.1964	Bergamot oil	STATE Liquid film		$n \frac{2}{D} 1 \frac{4625}{D}$

3500, 3082, 2965, 2925, 2850, 1778, 1744, 1680, 1647, 1450, 1437, 1412, 1372, 1243, 1170,
1155, 1111, 1094, 1018, 993, 943, 915, 888, 833, 796.

Fig 5

主要吸収は Linalyl acetate (1778) によるもの。

1647, 1437, 1155, 888, 798, は D - Limonene (1155), 3500, 1647, 993, 915 は L - Linalool (19) によるもの。



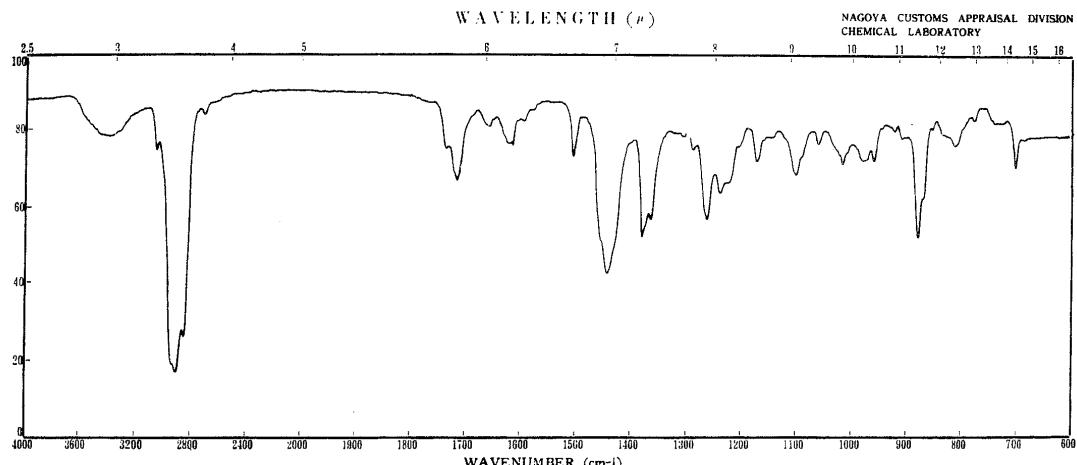
SPECTRUM No.	SAMPLE No.39 Bois de rose oil (Rose wood oil)	INSTRUMENT JASCO IR-S STATE Liquid film	ORIGIN MAKER	SG $\frac{2}{4}^0$ 0 $\frac{8735}{[\alpha]^{10}} \frac{D}{D} -3\frac{4}{4}^{\circ}$ $n_{D}^{20} 1 \frac{4595}{}$
DATE Feb. 1965				

3400, 3086, 2970, 2924, 2854, 1710, 1642, 1452, 1414, 1377, 1263, 1234, 1205, 1165,
1115, 995, 921, 836, 800, 735, 690.

Fig 6

Linalool (19) と同一吸收。

1165, 800 がやゝ Linalool より強いのは - Terpineol によるもの。



SPECTRUM No.	SAMPLE No. 13 Cananga oil	INSTRUMENT JASCO IR-S STATE Liquid film	OKIGIN Naarden MAKER Java	SG $\frac{2}{4}^0$ 0 $\frac{9140}{[\alpha]^{10}} \frac{D}{D} -21^z$ $n_{D}^{20} 1 \frac{4650}{}$
DATE Jan. 1965				

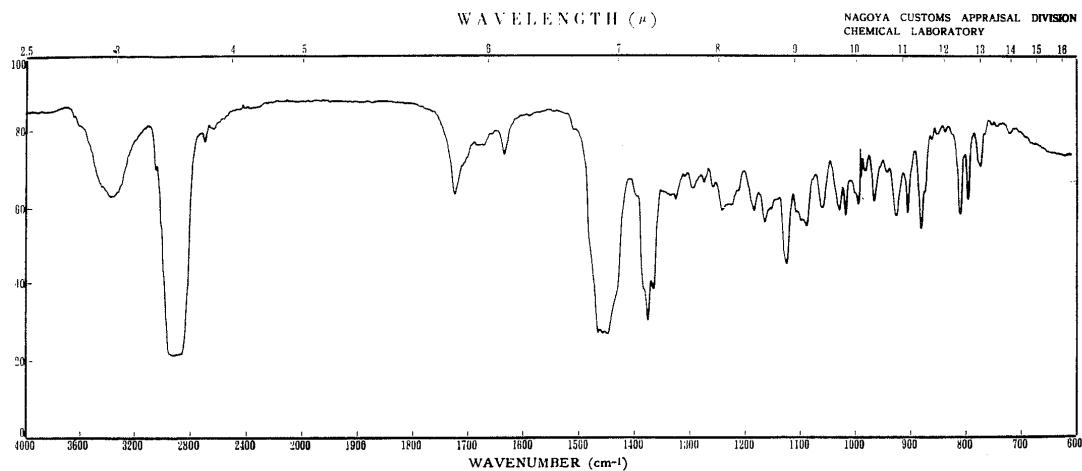
3460, 3075, 2955, 2926, 2860, 1743, 1726, 1668, 1636, 1605, 1515, 1451, 1383, 1368,
1270, 1247, 1198, 1108, 1068, 1025, 986, 964, 885, 818, 708.

Fig 7

Ylang ylang oil (第 44 図参照) に類似した吸収を示す。

Ester の含有量が少ないので 1720 ~ 1740 の C = O 吸収が弱い。

特に主要成分がない。



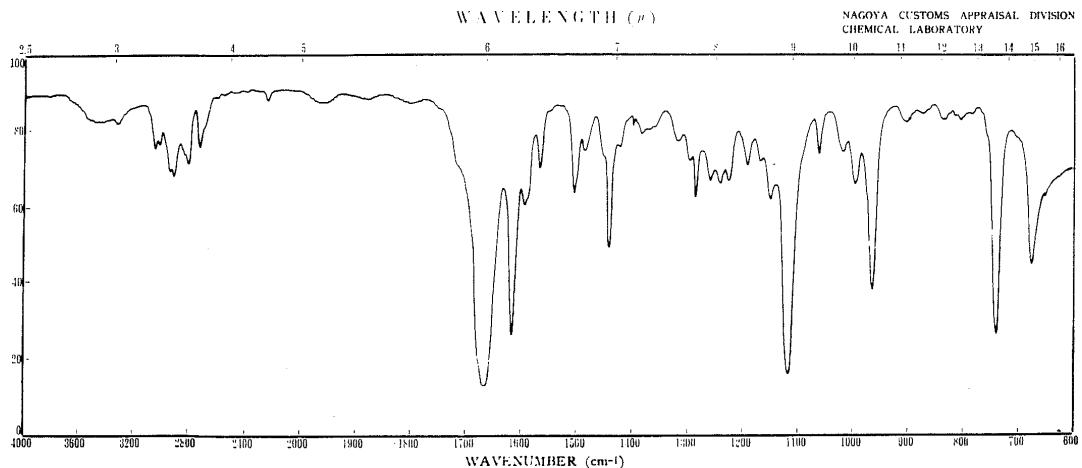
SPECTRUM #	SAMPLE # 16	INSTRUMENT JASCO IR-S	ORIGIN	SG $^{20}_4$ 9563 $[\alpha]^{13}_D -34^{\circ}$
DATE Jan. 1965	Cederwood oil	STATE Liquid film	MAKER M M R	n $^{20}_D$ 1-4995

3400, 2950, 2860, 1730, 1646, 1469, 1456, 1376, 1365, 1243, 1228, 1187, 1127,
1095, 1062, 1033, 1022, 998, 987, 969, 929, 910, 885, 814, 798, 775.

Fig 8

主要吸収は Cedrene によるもの。

3400, 1469, 1376, 1365, 1127, 1095, 969 は Cedrol (2230) によるもの。



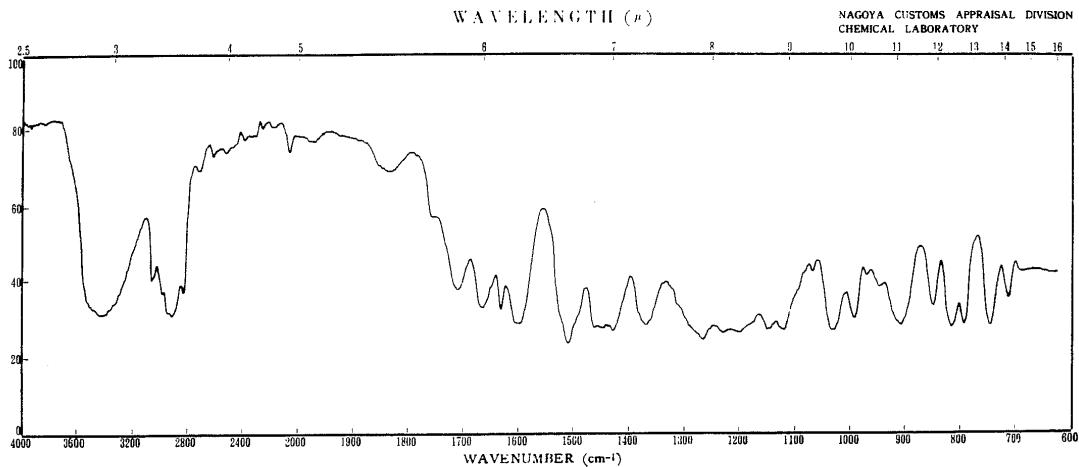
SPECTRUM #	SAMPLE # 14	INSTRUMENT JASCO IR-S	ORIGIN	$\text{SG}_{\frac{2}{4}}^{20} 1 \underline{0340} [\alpha]_{\text{D}}^{10} -0^{97}$
DATE Jan. 1965	Cinnamon bark oil	STATE Liquid film	MAKER	$n_{\text{D}}^{20} 1 \underline{5900}$

3335, 3060, 3028, 2955, 2920, 2810, 2738, 1675, 1628, 1607, 1575, 1515, 1498, 1451,
1434, 1328, 1307, 1296, 1270, 1253, 1237, 1204, 1161, 1125, 1075, 1032, 1007, 975,
920, 850, 820, 797, 749, 690.

Fig 9

主要吸収は Cinnamic aldehyde によるもの。

Cinnamon leaf oil に較べ Eugenol が少ない(4~10%), 2738 は Aldehyde の隣接 - CH 吸収。



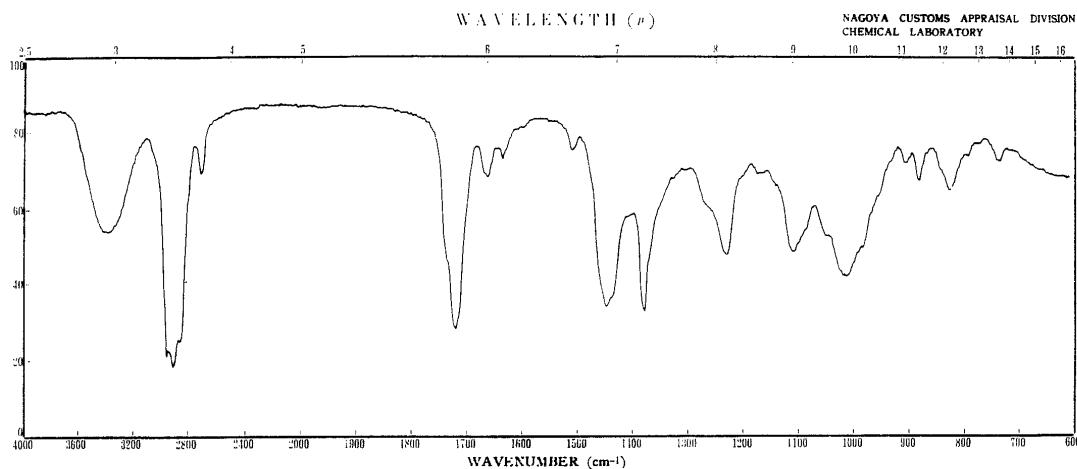
SPECTRUM #	SAMPLE # 15	INSTRUMENT JASCO IR-S	ORIGIN	$\text{SG}_{\frac{2}{4}}^{20} 1 \underline{0756} [\alpha]_{\text{D}} —$
DATE Jan. 1965	Cinnamon leaf oil	STATE Liquid film	MAKER	$n_{\text{D}}^{20} 1 \underline{5425}$

3510, 3060, 3005, 2970, 2935, 2900, 2835, 1717, 1670, 1640, 1615, 1605, 1515, 1465,
1452, 1433, 1370, 1268, 1233, 1205, 1182, 1150, 1122, 1035, 995, 914, 850, 817,
794, 747, 713.

Fig 10

主要吸収は Eugenol によるもの。

1670 は Cinnamic aldehyde, 1717 はその他の C=O 化合物の吸収。



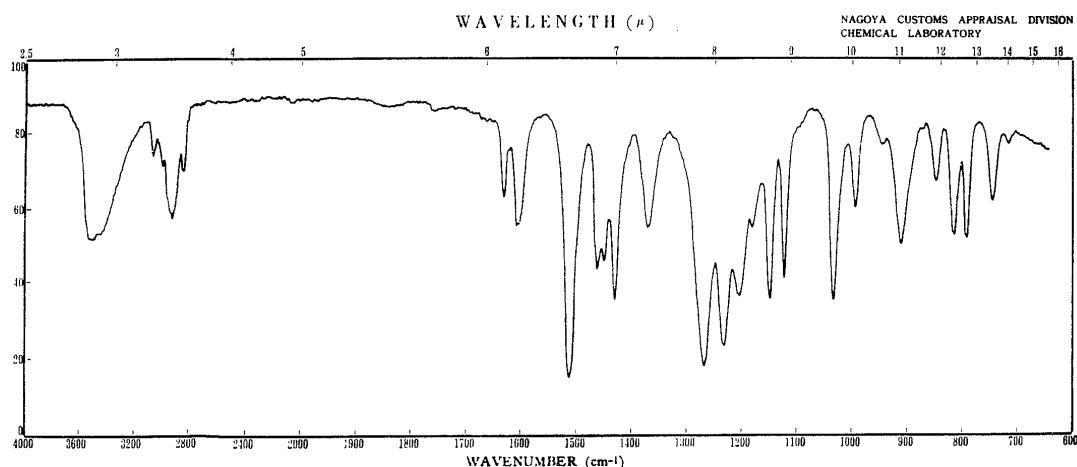
SPECTRUM #	SAMPLE # 17	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4}$ 0 $\frac{8869}{8}$ [α] D -4 $\frac{8}{0}$
DATE Jan. 1965	Citronella oil	STATE Liquid film	MAKER	n $\frac{2}{D}$ 1 $\frac{4640}{8}$

3 4 0 0, 2 9 6 2, 2 9 1 5, 2 8 7 0, 2 8 5 0, 2 7 2 0, 1 7 2 6, 1 6 7 1, 1 6 4 5, 1 5 1 6,
1 4 5 3, 1 4 4 8, 1 3 7 9, 1 2 3 3, 1 1 1 0, 1 0 2 0, 8 8 8, 8 2 8 .

Fig 11

主要吸収は - - - Citronellal (2073), Geraniol (1773) によるもの。

3400 (Geraniol の -OH) と 1726 (Citronellal の C=O), 又は 2720 (Citronellal の C=O 隣接 -CH) の相対強度により , セイロン産とジヤバ産の区別も可能。

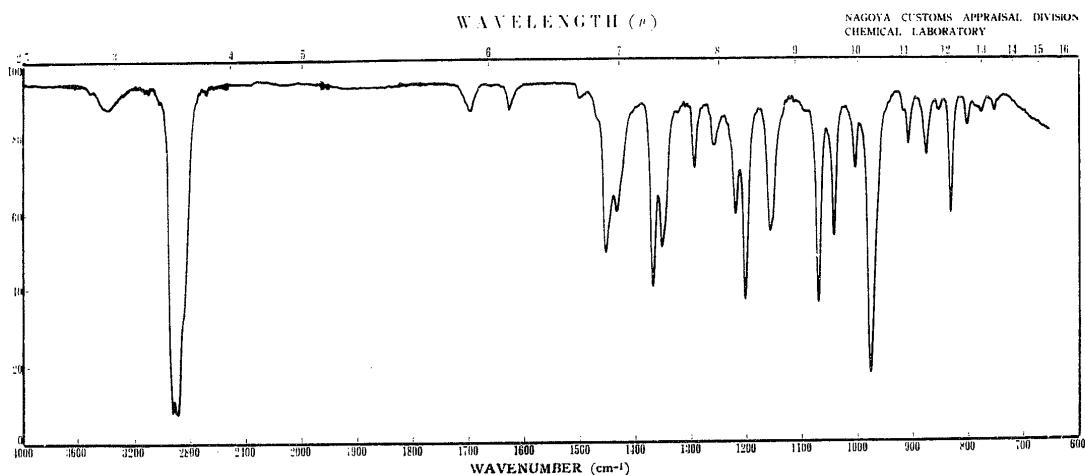


SPECTRUM No.	SAMPLE No. 18	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4} 0$ 1 0473 [α] D
DATE Jan, 1965	Glove oil	STATE Liquid film	MAKER	n $\frac{2}{D} 0$ 1 5295

3510, 3440, 3060, 3000, 2900, 2835, 1640, 1615, 1512, 1465, 1452, 1433, 1370, 1268,
1230, 1205, 1180, 1150, 1122, 1036, 995, 945, 914, 850, 817, 794, 747.

Fig 12

Eugenol の吸収に同じ。



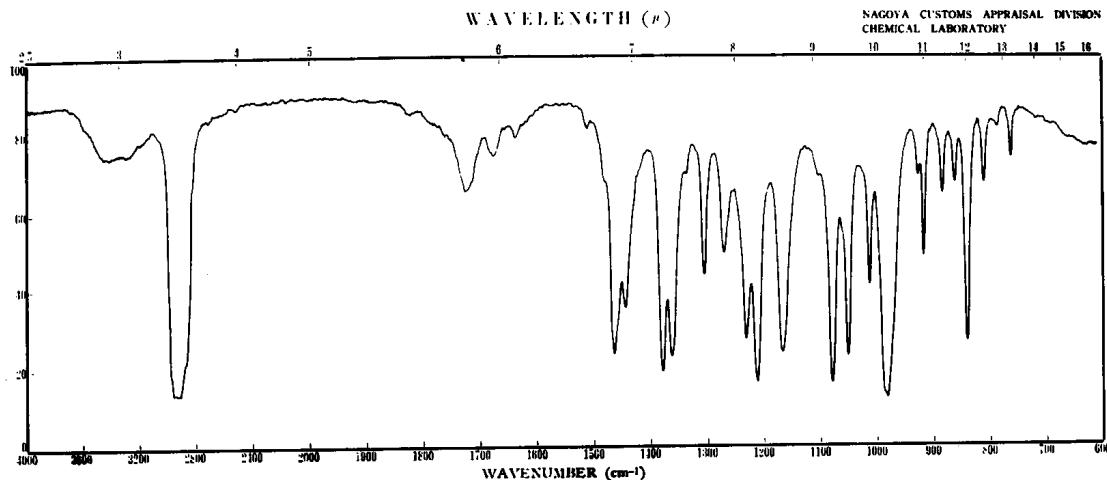
SPECTRUM No.	SAMPLE No. 54	INSTRUMENT JASCO IR-R	ORIGIN Spain	SG $\frac{1}{4} 5 0$ 9308 [α] $\frac{1}{D} 2 + 4 . 5 ^\circ$
DATE Mar, 1965	Eucalyptus oil	STATE Liquid film	MAKER	n $\frac{2}{D} 0$ 1 4600

3455, 2965, 2915, 2870, 1710, 1644, 1467, 1445, 1375, 1360, 1305, 1270, 1233, 1211,
1166, 1080, 1052, 1014, 986, 918, 886, 842, 812.

Fig 13

主要吸収は Cineol によるもの。1710, 1644 は Cineol にはない。

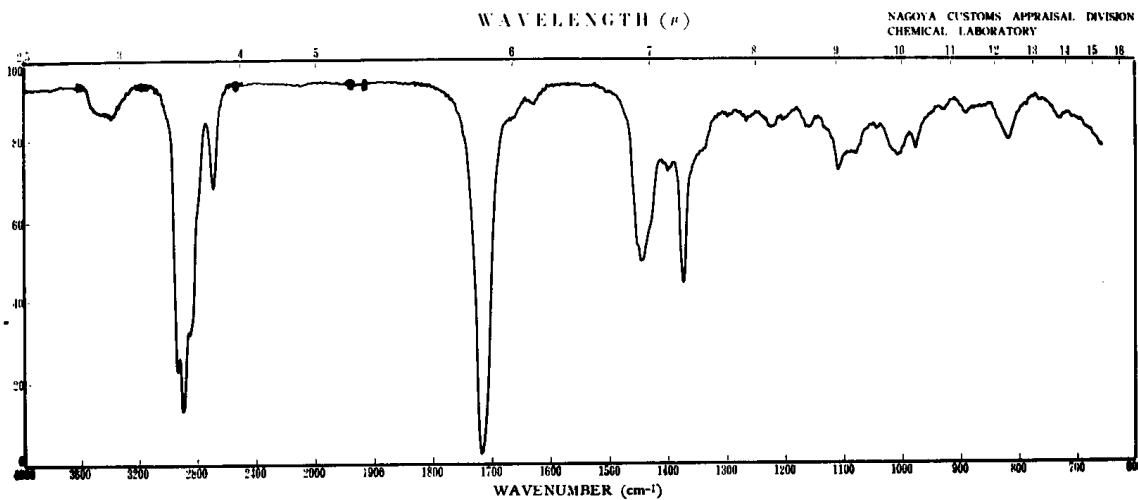
赤外線吸収スペクトルによる植物精油の分析



2965, 2938, 2921, 2870, 2848, 2728, 1467, 1445, 1375, 1360, 1305, 1270, 1233,
1211, 1166, 1080, 1052, 1014, 986, 918, 886, 842, 812, 754.

Fig 14

主要吸収は Cineol によるもの。Cineol には 1600, 1720 の吸収はない。



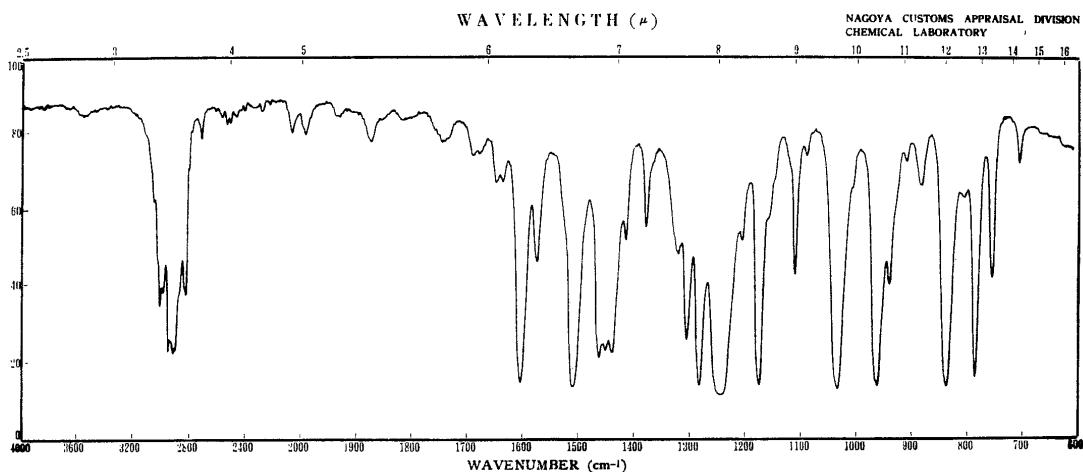
SPECTRUM No.	SAMPLE No. 53	INSTRUMENT JASCO IR-S STATE Liquid film	ORIGIN Brazil MAKER	SG $\frac{1}{4} 0.8669 [\alpha]_{D}^{12} + 1^2$ $n_{D}^{20} 1.4475$
DATE Mar. 1965	Eucalyptus Citriodora oil			

3440, 2955, 2910, 2810, 2710, 1726, 1458, 1453, 1410, 1379, 1346, 1275, 1225,
1167, 1115, 1087, 1050, 1015, 985, 900, 828, 740.

Fig 15

主要吸収は - - Citronellal (2073) によるもの。

2710 (Aldehyde 隣接 - CH), 1726 (Aldehyde の C = O) の吸収は特徴。



SPECTRUM No.	SAMPLE No. 20	INSTRUMENT JASCO IR-S STATE Liquid film	ORIGIN	SG $\frac{2}{4} 0.9645 [\alpha]_{D}^{13} + 7^6$ $n_{D}^{20} 1.5470$
DATE Jan. 1965	Fennel oil		MAKER	

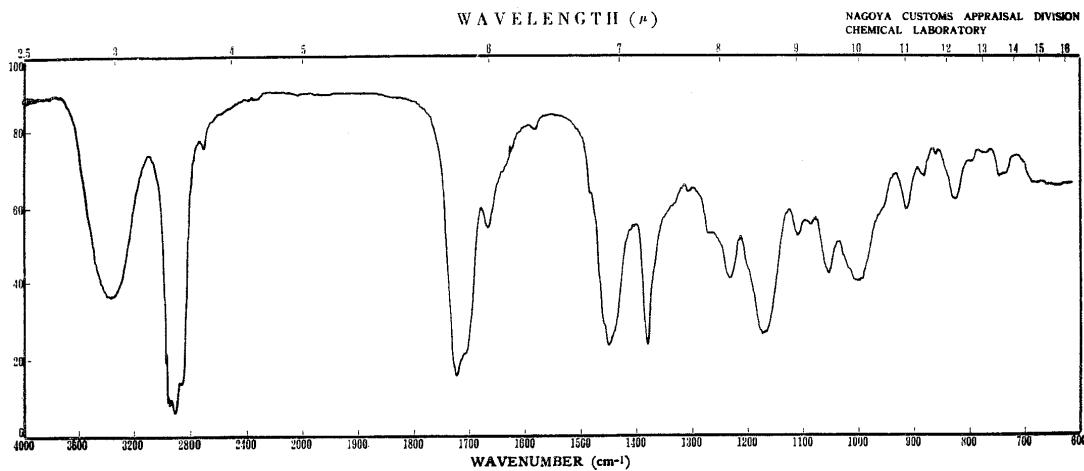
3022, 3008, 2952, 2927, 2912, 2828, 1888, 1750, 1657, 1647, 1610, 1577, 1514,
1466, 1455, 1444, 1418, 1378, 1324, 1306, 1283, 1247, 1208, 1174, 1112, 1037,
963, 942, 888, 838, 792, 755, 711.

Fig 16

主要吸収は Anethol (1438) によるもの。

883, 786 は - d - Pinene の吸収。

755, 786, 836 の強度は Anise oil, Star anise oil に較べ異なる。

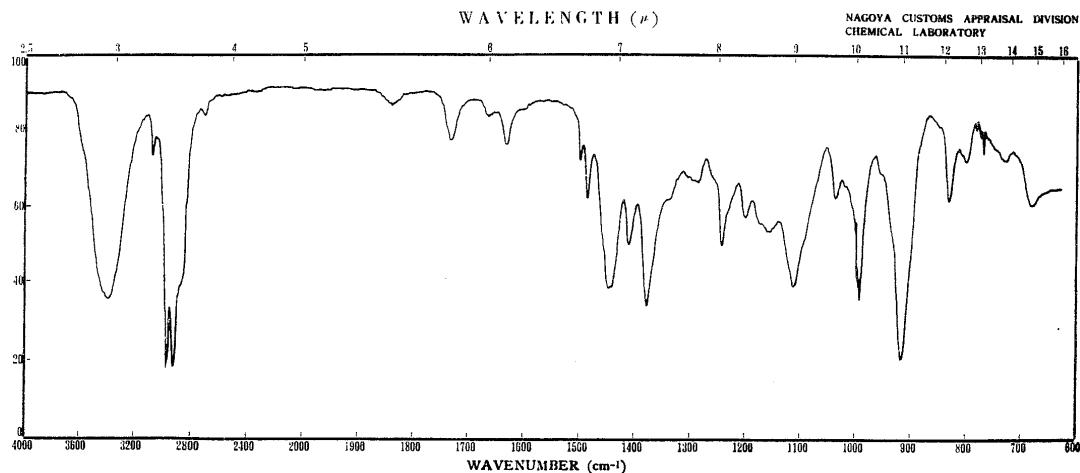


SPECTRUM NO.	SAMPLE NO. 31	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4} 0 8944$ $[\alpha]_{D}^{13} -11^3$
DATE Jan. 1965	Geranium oil	STATE Liquid film	MAKEK Bourbon	n $\frac{2}{D} 1 4620$

3400, 2965, 2922, 2870, 1730, 1713, 1672, 1585, 1463, 1453, 1377, 1235, 1172, 1110, 1058, 1008, 916, 888, 830, 746.

Fig 17

Geraniol (1773) と Citronellol を主成分とするものとされているが、1730, 1713 (C=O) の吸収は不明。1672 は Geraniol の C=C 結合によるもの。



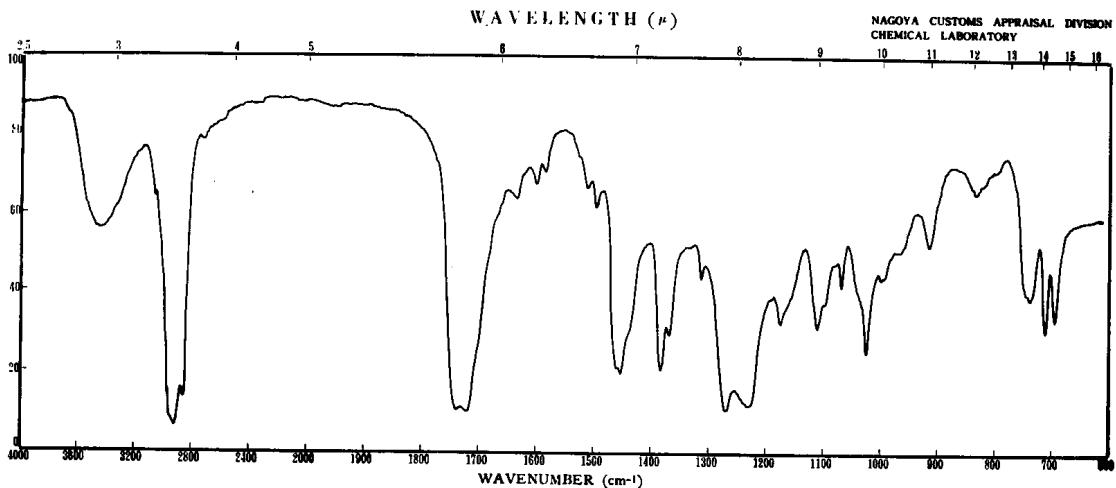
SPECTRUM #	SAMPLE # 35	INSTRUMENT JASCO IR-S	ORIGIN MAKER	SG $\frac{2}{4} 0 8771$ $[\alpha]^{13}_{D} -16 \frac{8}{1}$ $n^2_0 D 1 4615$
DATE Feb. 1965	Ho wood oil	STATE Liquid film		

3400, 3086, 2970, 2924, 2854, 1737, 1644, 1506, 1492, 1446, 1414, 1367, 1246, 1205,
1165, 1113, 1042, 995, 921, 836, 805, 735, 690.

Fig 18

主要吸収は Linalool (19) によるもの。

1737, 1506 等は Camphor によるもの。



SPECTRUM #	SAMPLE # 38	INSTRUMENT JASCO IR-S	ORIGIN France MAKER P. R.	SG $\frac{2}{4} 0 9421$ $[\alpha]_D$ $n^2_0 D 1 4860$
DATE Feb. 1965	Jasmin oil	STATE Liquid film		

3450, 2923, 2953, 2853, 1742, 1727, 1636, 1602, 1580, 1515, 1500, 1456, 1380,
1365, 1314, 1270, 1230, 1173, 1108, 1096, 1072, 1024, 918, 740, 714, 698.

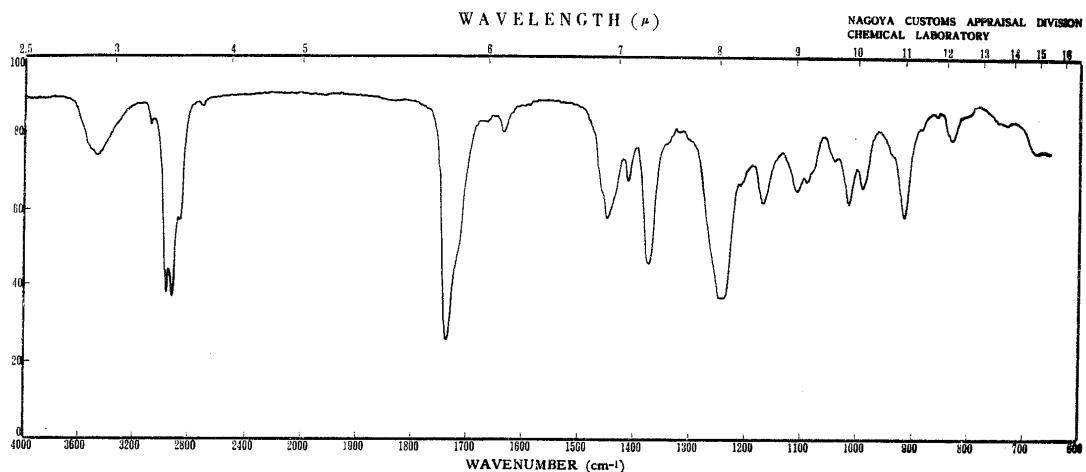
Fig 19

主要吸収は Benzyl alcohol, Benzyl acetate, Linolool (19) によるもの。

SPECTRUM No.	SAMPLE No. 45	INSTRUMENT JASCO IR-S	ORIGIN Italy	SG $^{2.0}_{4}$ 1 0083 [α] D
DATE Mar. 1965	Jasmine oil (Absolute)	STATE Liquid film	MAKER G. Cupus	n $^{2.0}_{D}$ 1 4935

3450, 2953, 2923, 2853, 1730, 1636, 1602, 1580, 1515, 1500, 1455, 1380, 1368,
1275, 1173, 1121, 1096, 1072, 1040, 1024, 962, 918, 862, 843, 743, 714, 698.

Fig 20

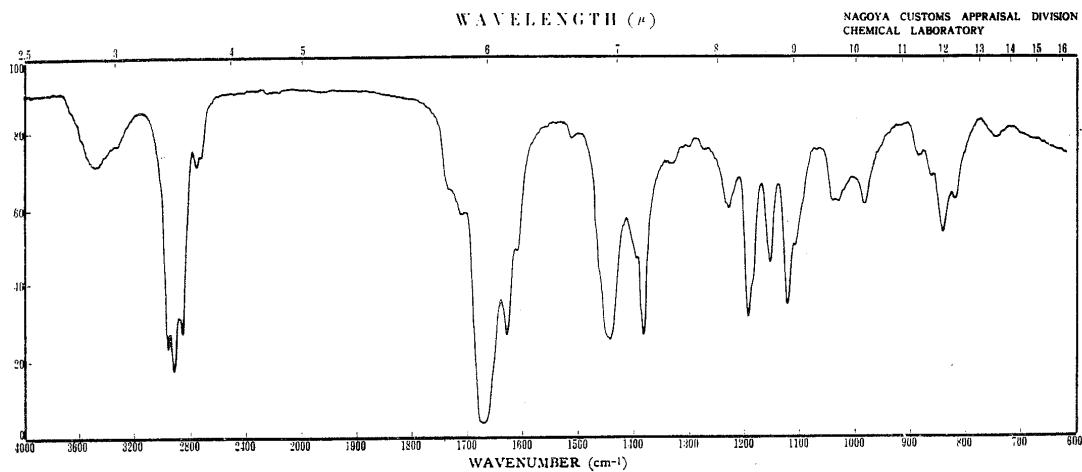


SPECTRUM No.	SAMPLE No. 32	INSTRUMENT JASCO IR-S	ORIGIN France	SG $^{2.2}_{4}$ 0 8879 [α] $^{14}_{D}-70^{\circ}$
DATE Feb. 1965	Lavender oil	STATE Liquid film	MAKER P. R.	n $^{2.0}_{D}$ 1 4570

3470, 3086, 2963, 2921, 2870, 1740, 1645, 1452, 1414, 1374, 1243, 1172, 1108,
1094, 1045, 1018, 993, 920, 833, 690

Fig 21

3470, 993 の Linalool (19) による吸収以外は殆んど Linalyl acetate (1778) の吸収。

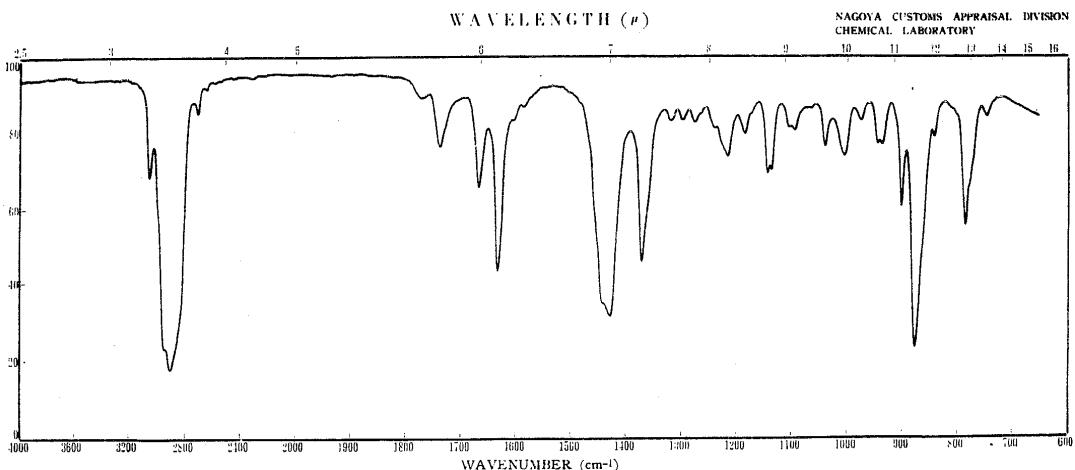


SPECTRUM No.	SAMPLE No. 33	INSTRUMNT JASCO IR-S	ORIGIN	SG $^{22}_4$ 0 <u>8951</u> [a] D
DATE Feb. 1965	Lemongrass oil (79%)	STATE Liquid film	MAKER	n $^{20}_D$ 1-4845

3500, 2967, 2918, 2853, 1710, 1675, 1635, 1613, 1445, 1396, 1378, 1230, 1194,
1153, 1120, 1040, 1032, 984, 887, 862, 840, 819.

Fig 22

1675, 1635, 1613, 1445, 1378, 1230, 1194, 1153, 1120, 1032, 984 等は Citral によるもの。



SPECTRUM No.	SAMPLE No. 21	INSTRUMENT JASCO IR-S	ORIGIN U.S.A. California	SG $\frac{1}{4} 08520$ [α] $\frac{1}{D} 3 + 68.6^\circ$
DATE Jan 1965	Lemon oil	STATE Liquid film	MAKER	n $\frac{2}{D} 1 4700$

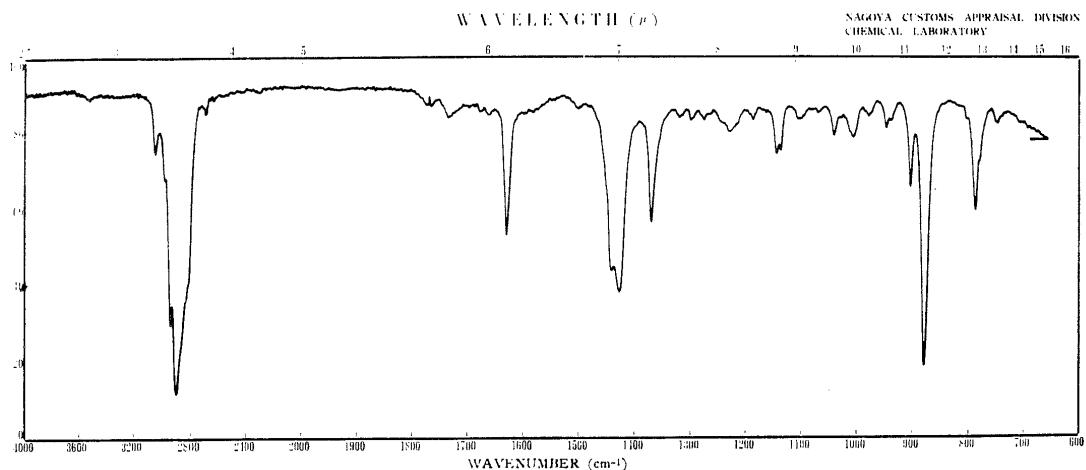
3065, 2965, 2915, 2848, 2828, 1745, 1680, 1647, 1454, 1437, 1378, 1228, 1197, 1155,
1146, 1050, 1015, 956, 945, 915, 888, 802, 790,

Fig 23

主要吸収は D - Limonene (1155) によるもの。

1745, 1680 は Citral の C = O , 末端メチレン (C = C) によるもの。

他の Citrus 系精油 (Orange oil, Tangerine oil, Mandarin oil, Yuzu oil) に較べて強い。



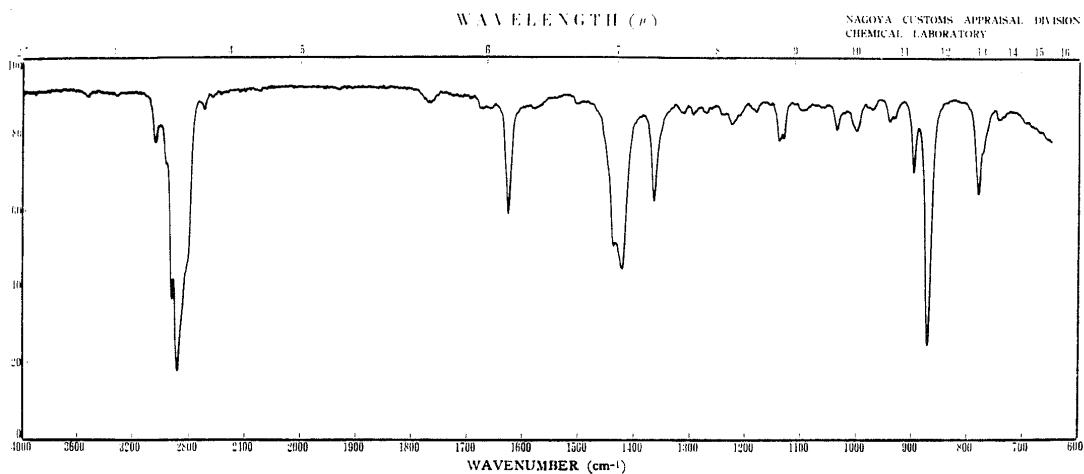
SPECTRUM No.	SAMPLE No. 57	INSTRUMENT JASCO IR-S	ORIGIN Sicily	SG $\frac{1}{4} 08545$ [α] $\frac{1}{D} 2 + 100.9^\circ$
DATE Feb 1965	Mandarin oil	STATE Liquid film	MAKER Polak's Frutal	n $\frac{2}{D} 1 4700$

3065, 3008, 2965, 2915, 2848, 2828, 1647, 1454, 1437, 1378, 1243, 1197, 1155,
1146, 1115, 1050, 1015, 990, 956, 915, 888, 798, 788, 758.

Fig 24

D - Limonene (1155) の吸収に同じ。

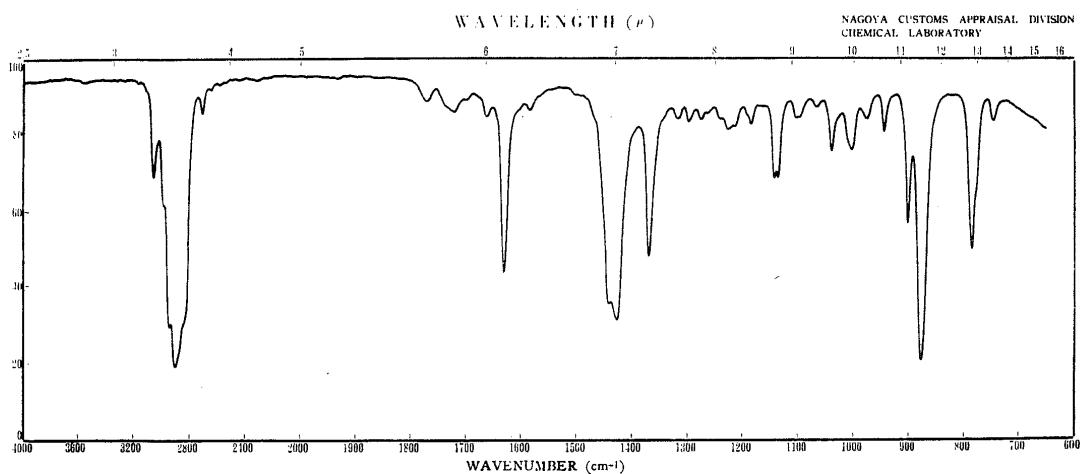
Lemon oil (第 23 図) 参照。



SPECTRUM #	SAMPLE # 56	INSTRUMENT JASCO IR-S	ORIGIN Sicily	$\text{SG } \frac{2}{4} 0 \underline{8512} [\alpha] \frac{1}{D} + 103 \frac{1}{D}^{\circ}$
DATE Feb. 1965	Mandarin oil (Commercial)	STATE Liquid film	MAKER Polaks Frutal	$n \frac{2}{D} 1 \underline{4700}$

3 0 6 5, 3 0 0 8, 2 9 6 5, 2 9 1 5, 2 8 4 8, 2 8 2 8, 1 6 4 7, 1 4 5 4, 1 4 3 7, 1 3 7 8,
1 1 5 5, 1 1 4 6, 1 0 5 0, 1 0 1 5, 9 9 0, 9 5 6, 9 1 5, 8 8 8, 7 9 8, 7 8 8, 7 5 8.

Fig 25



SPECTRUM No.	SAMPLE No. 22	INSTRUMENT JASCO IR-S	ORIGIN U.S.A. Florida MAKER	SG $\frac{1}{4} 0 \underline{8464} [\alpha] \frac{1}{D} + 114 \frac{8}{0}$ $n \frac{2}{D} 1 \underline{4680}$
DATE Jan. 1965	Orange oil	STATE Liquid film		

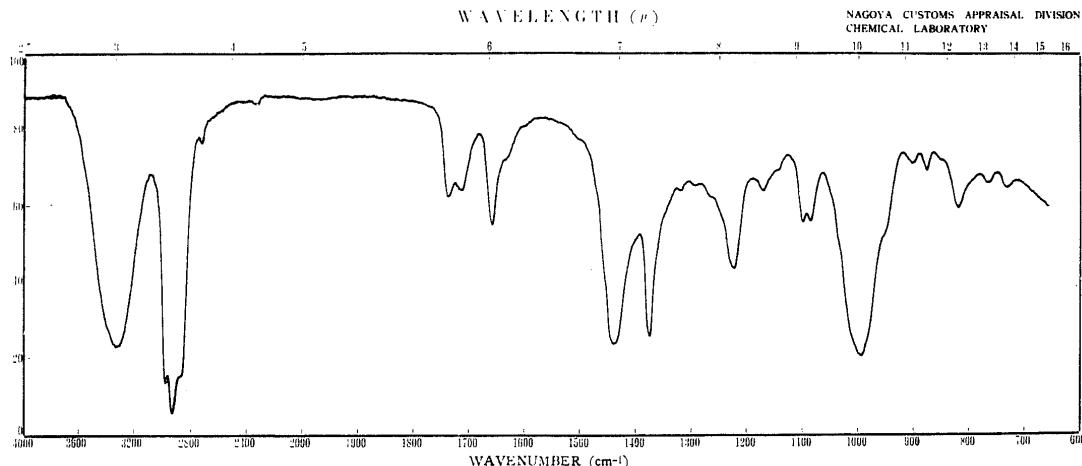
3084, 3010, 2965, 2920, 2850, 2830, 1787, 1732, 1680, 1647,
1455, 1438, 1380, 1155, 1147, 1051, 1016, 988, 956, 914, 887,
796, 788, 756.

Fig 26

主要吸収は D - Limonene (1155) に同じ。

1680, 1732 は Citral の吸収。

Lemon oil (第 23 図) 参照。



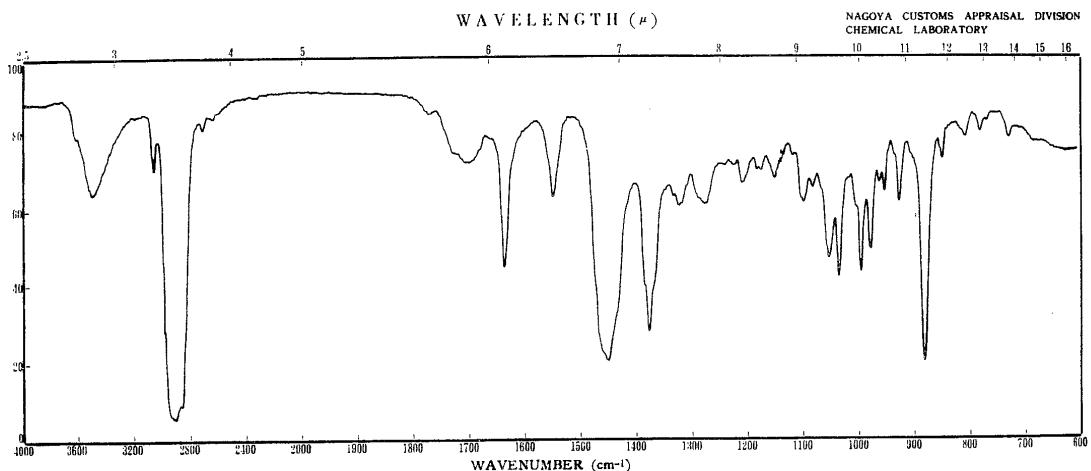
SPECTRUM No.	SAMPLE No. 23	INSTRUMENT JASCO IR-S	ORIGIN SAS MAKER Mero	SG $\frac{2}{4} 0 \underline{8913} [\alpha] \frac{1}{D} + 0 \frac{6}{0}$ $n \frac{2}{D} 1 \underline{4720}$
DATE Jan. 1965	Palmarosa oil	STATE Liquid film		

3347, 2966, 2924, 2851, 1740, 1722, 1668, 1450, 1445, 1380,
1233, 1183, 1108, 1095, 1002, 888, 831, 780, 743.

Fig 27

主要吸収は Geraniol (1773) によるもの。

1740, 1722, 1233 は Citral, Citronelal の吸収。

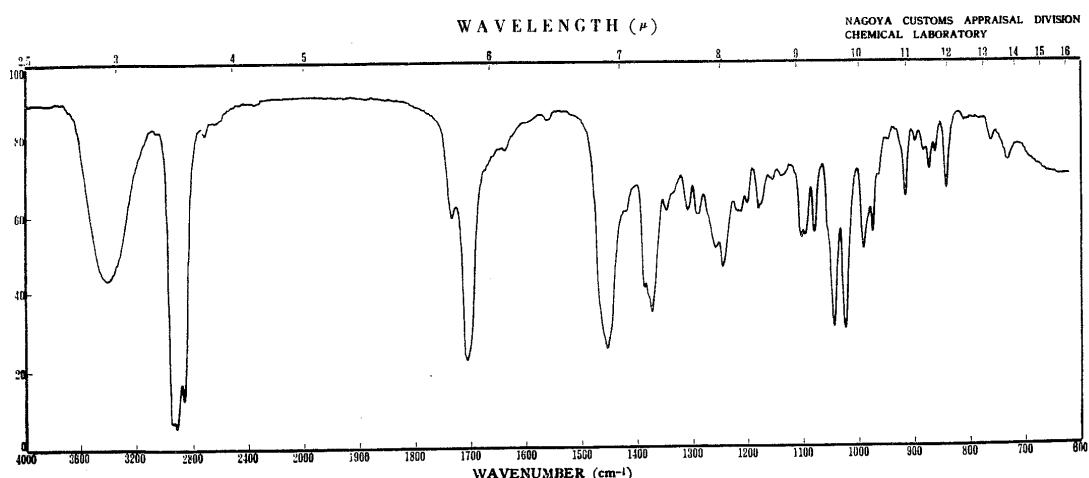


SPECTRUM NO.	SAMPLE NO. 34	INSTRUMENT JASCO IR-S	ORIGIN Penang MAKER	$\text{SG } \frac{2}{4} 0.9637 [\alpha] \text{ D}$ $n \frac{2}{4} 1.5045$
DATE Feb 1965	patchouli oil	STATE Liquid film		

3500, 3075, 2955, 2925, 2868, 1647, 1553, 1455, 1377, 1060,
1041, 1002, 983, 933, 888.

Fig 28

1647, 888 等の特異吸収から末端メチレン等の二重結合の存在が認められるが主要成分は推定出来ない。
No.1553, 1000 領域の吸収から芳香族の存在を認む。

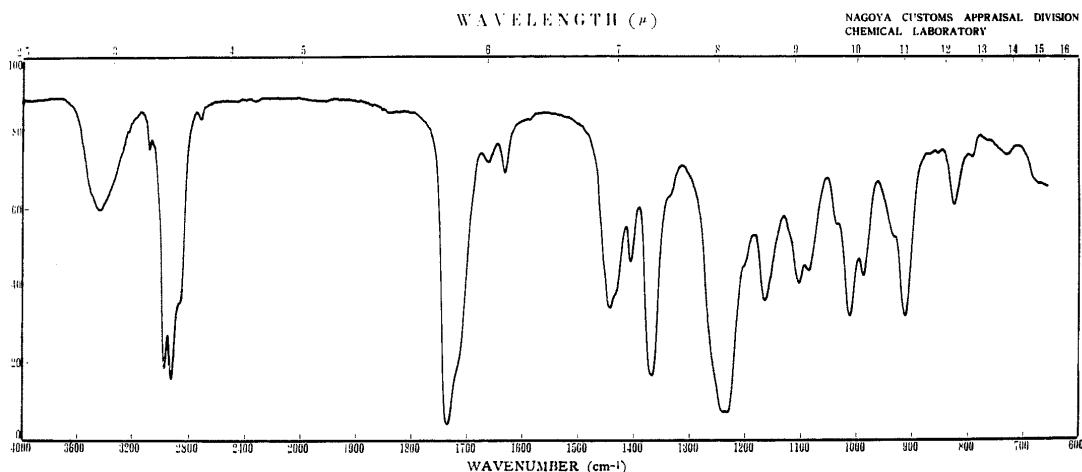


SPECTRUM #	SAMPLE # 37	INSTRUMENT JASCO IR-S	ORIGIN	SG ²² ₄ 0.9003 [α] ¹³ _D -22 ^{8°}
DATE Feb. 1965	Peppermint oil	STATE Liquid film	MAKER	n ²⁰ _D 1 4580

3410, 2970, 2960, 2868, 1737, 1712, 1451, 1357, 1322, 1348,
 1307, 1290, 1245, 1202, 1182, 1103, 1098, 1079, 1046, 1027,
 995, 975, 918, 875, 847, 733.

Fig 29

主要吸収は Menthol (1105) によるもの。
 1712, 1463 は Menthone (1775), 1737 は Menthol ester の吸収。

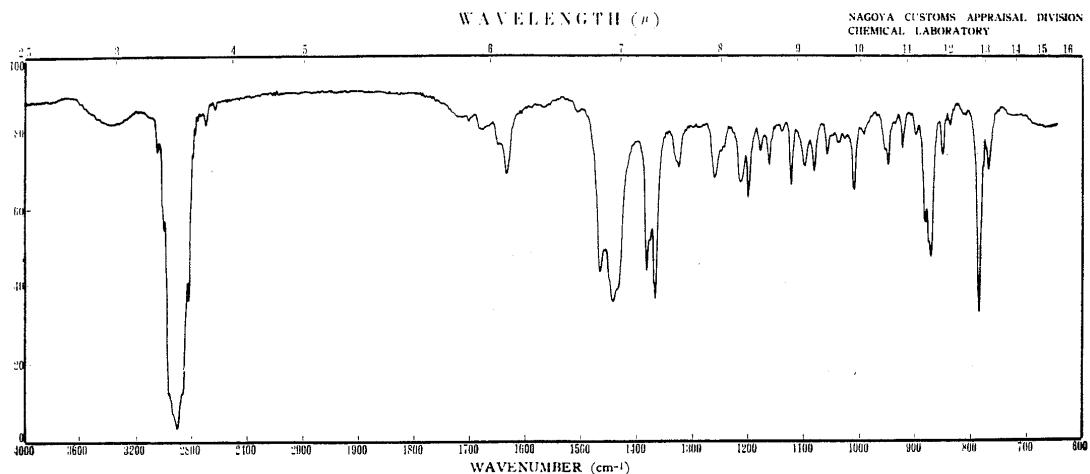


SPECTRUM #	SAMPLE # 24	INSTRUMENT JASCO IR-S	ORIGIN Paraguay	SG ¹⁹ ₄ 0.8934 [α] ¹² _D -42°
DATE Jan. 1965	Petitgrain oil	STATE Liquid film	MAKER	n ²⁰ _D 1 4540

3402, 3092, 2972, 2928, 2858, 1743, 1677, 1647, 1464, 1453,
 1415, 1374, 1240, 1172, 1093, 1045, 1020, 994, 941, 920,
 834, 800, 741, 692.

Fig 30

主要吸収は Linalyl acetate (1778) によるもの。
 1100 領域の逆吸収は Linalool (19), 1677 は Nerol (1787) 又は Geraniol (1773) によるもの。
 3402 はそれらの -OH 吸収。

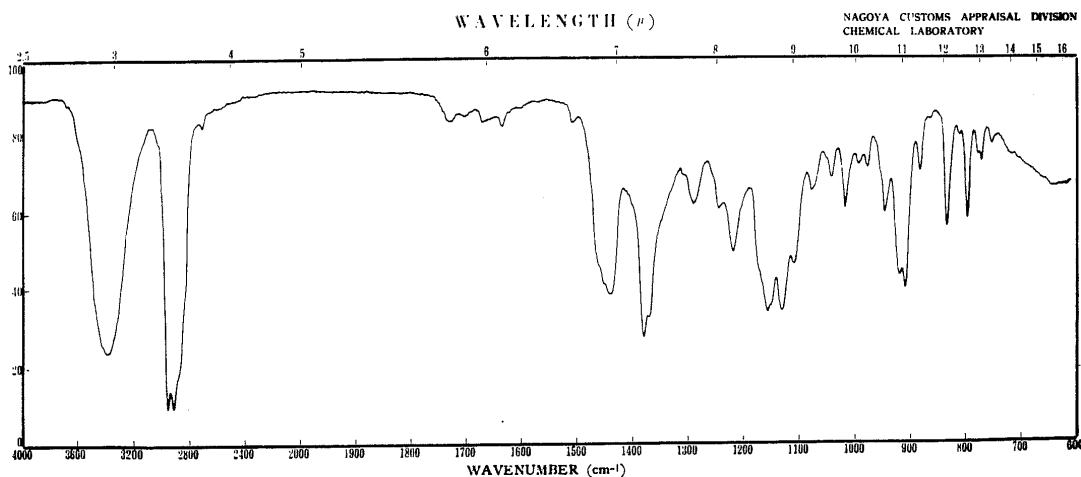


SPECTRUM No.	SAMPLE No. 5	INSTRUMENT JASCO IR-S	ORIGIN	$\text{SG}^{2.0}_4 0.8801 [\alpha]^{1.5}_D -3.6^\circ$
DATE Mar. 1965	Pine oil	STATE Liquid film	MAKER	$n^{2.0}_D 1.4700$

2985, 2915, 2880, 2830, 1644, 1470, 1447, 1437, 1383, 1366,
1328, 1262, 1217, 1202, 1123, 1100, 1084, 1062, 1013, 950,
924, 885, 872, 851, 785, 767.

Fig 31

主要吸収は - Pinene によるもの。

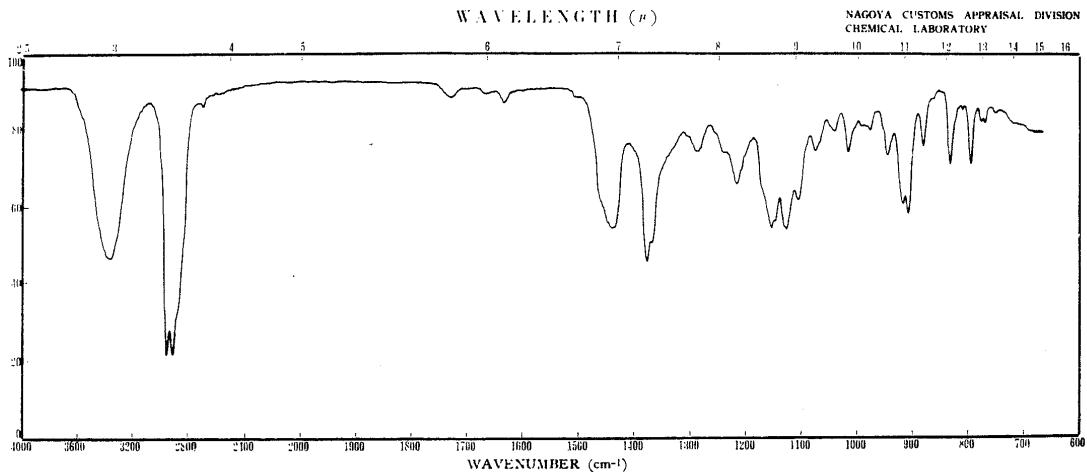


SPECTRUM #	SAMPLE # 41	INSTRUMENT JASCO IR-S	ORIGIN U.S.A.	SG	$[\alpha]_D$
DATE Aug. 1964	Pine oil (# 230)	STATE Liquid film	MAKER Glidden	n_D	

3375, 2965, 2925, 1735, 1708, 1677, 1645, 1513, 1445, 1378,
 1368, 1290, 1250, 1222, 1158, 1132, 1110, 1080, 1045, 1026,
 997, 980, 948, 921, 912, 885, 835, 798, 771, 753.

Fig 32

主要吸収は - Terpineol (1729), 885 は - Pinene によるもの。

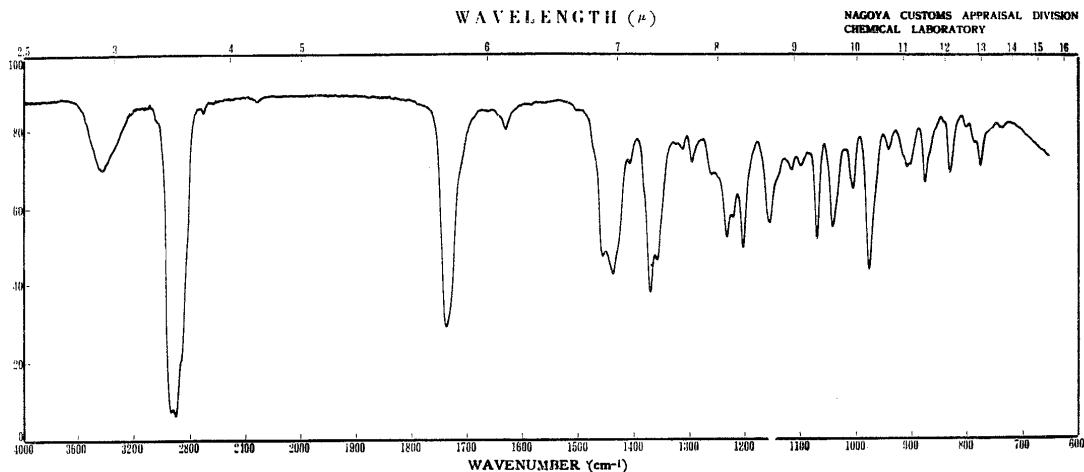


SPECTRUM #	SAMPLE # 42	INSTRUMENT JASCO IR-S	ORIGIN U.S.A.	SG $\frac{155}{4} 0 \underline{9292} [\alpha]_D^{15} D + 22^\circ$
DATE Aug. 1964	Pine oil (# 150)	STATE Liquid film	MAKER Glidden	$n_D^{25} 1 \underline{4780}$

3380, 2960, 2925, 1737, 1710, 1678, 1647, 1440, 1377, 1363,
 1290, 1223, 1157, 1132, 1108, 1080, 1047, 1021, 981, 950,
 921, 913, 886, 836, 798, 769, 753.

Fig 33

第32図に同じ。

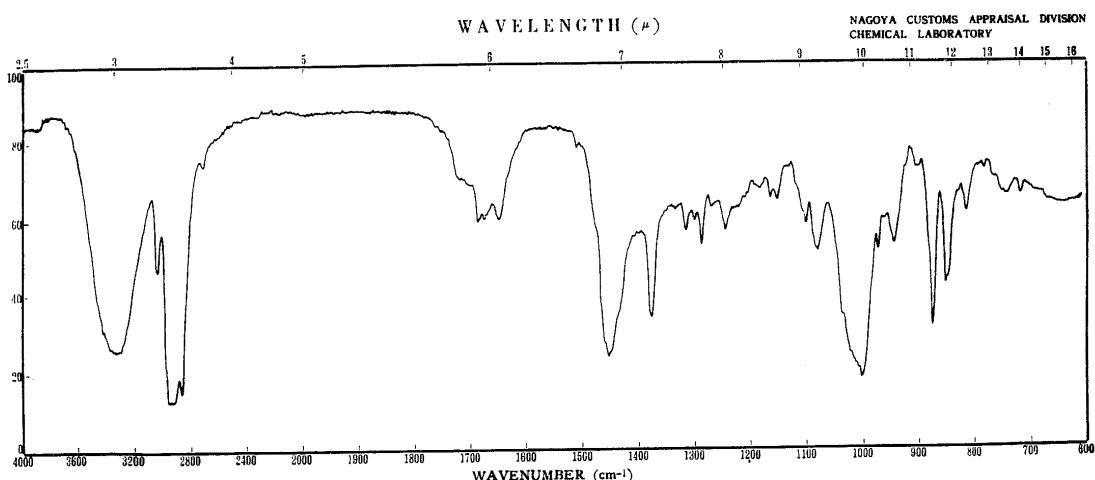


SPECTRUM NO.	SAMPLE NO. 25	INSTRUMENT JASCO IR-S	ORIGIN	$\text{SG}^{2.0}_4 \text{O}^{9096} [\alpha]^{1.2}_D + 4.1^\circ$
DATE Oct. 1964	Rosemary oil	STATE Liquid film	MAKER B F	$n^{2.0}_D 1 \text{ } 4650$

3 4 7 5, 2 9 6 9, 2 9 2 5, 2 8 8 0, 2 8 3 8, 1 7 4 6, 1 4 6 9, 1 4 5 0, 1 4 1 9, 1 3 9 2,
1 3 7 8, 1 3 6 7, 1 3 0 6, 1 2 4 5, 1 2 3 3, 1 2 1 4, 1 1 6 5, 1 0 8 1, 1 0 5 8, 1 0 1 7,
9 8 6, 9 5 1, 9 2 0, 8 8 7, 8 4 3, 7 8 7.

Fig 34

主要吸収は - Pinene , Cineole , Camphor によるもの。

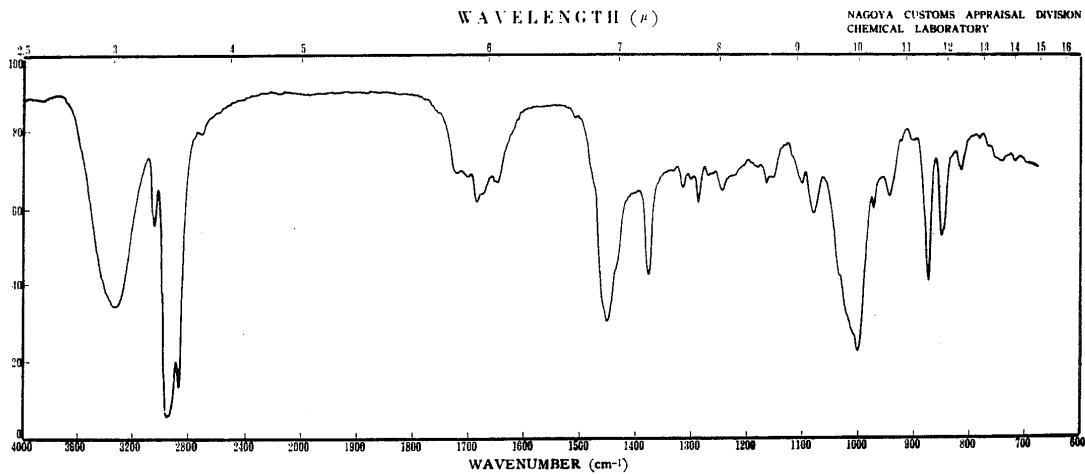


SPECTRUM No.	SAMPLE No. 26	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4} 0.9746$ [α] $^{12}D-17.6^{\circ}$
DATE Oct. 1964	Sandalwood oil	STATE Liquid film	MAKER	n $\frac{2}{4} 0.5025$

3340, 3052, 2952, 2922, 2873, 1725, 1712, 1694, 1682, 1661,
 1461, 1455, 1378, 1375, 1318, 1291, 1248, 1083, 1003, 977, 948,
 878. 853, 820.

Fig 35

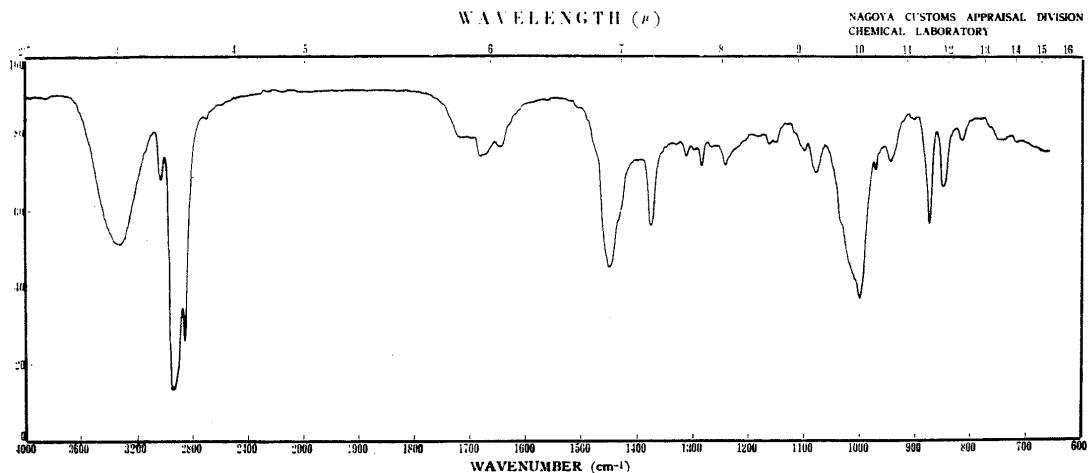
主要吸収は Santalol によるものと推定。



SPECTRUM No.	SAMPLE No. 47	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4} 0.9896$ [α] $^{15}D-18.2^{\circ}$
DATE Mar. 1965	Sandalwood oil	STATE Liquid film	MAKER	n $\frac{2}{4} 0.5035$

3340, 3055, 2960, 2875, 1732, 1694, 1656, 1455, 1376, 1317,
 1290, 1248, 1167, 1156, 1083, 1003, 975, 948, 878, 852,
 818.

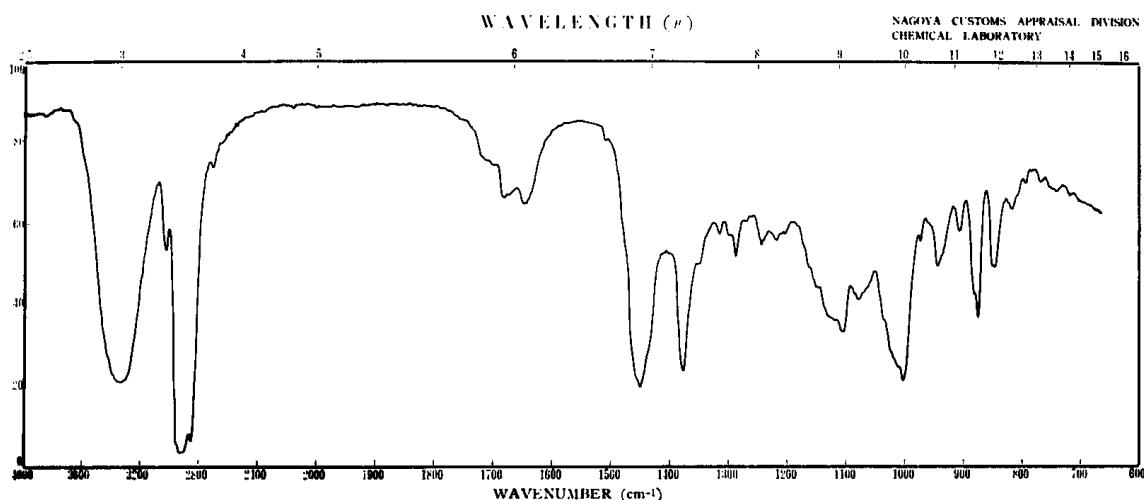
Fig 36



SPECTRUM #	SAMPLE # 6	INSTRUMENT JASCO IR-S	ORIGIN France	SG $[\alpha]_D$
DATE Mar. 1965	Sandalwood oil	STATE Liquid film	MAKER J&E Sojio	n^{20}_D 1 4980

3 4 4 5, 3 0 4 5, 2 9 3 5, 2 8 6 5, 1 7 2 7, 1 6 9 2, 1 6 6 0, 1 4 5 5, 1 3 7 7, 1 3 5 0,
1 2 8 8, 1 2 4 4, 1 1 0 5, 1 0 8 0, 1 0 0 3, 9 4 4, 9 1 0, 8 7 8, 8 5 0.

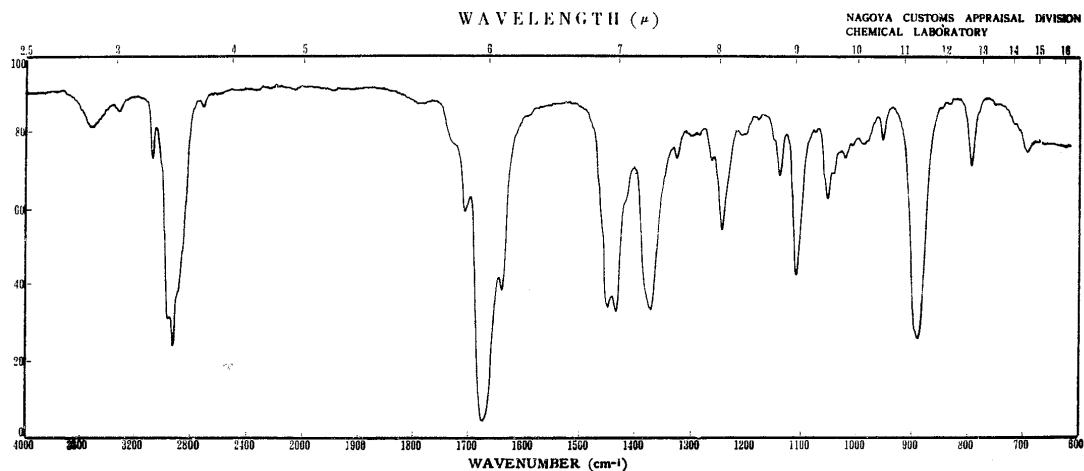
Fig 37



SPECTRUM No.	SAMPLE No. 3	INSTRUMENT JASCO IR-S	ORIGIN India Mysore	SG $[\alpha]_D$
DATE Jul. 1964	Sandalwood oil	STATE Liquid film	MAKER Essential Co.	n_D

3320, 3045, 2950, 2865, 1725, 1708, 1690, 1677, 1656, 1452,
 1375, 1316, 1288, 1245, 1166, 1102, 1082, 1003, 975, 947, 876,
 851, 818.

Fig 38

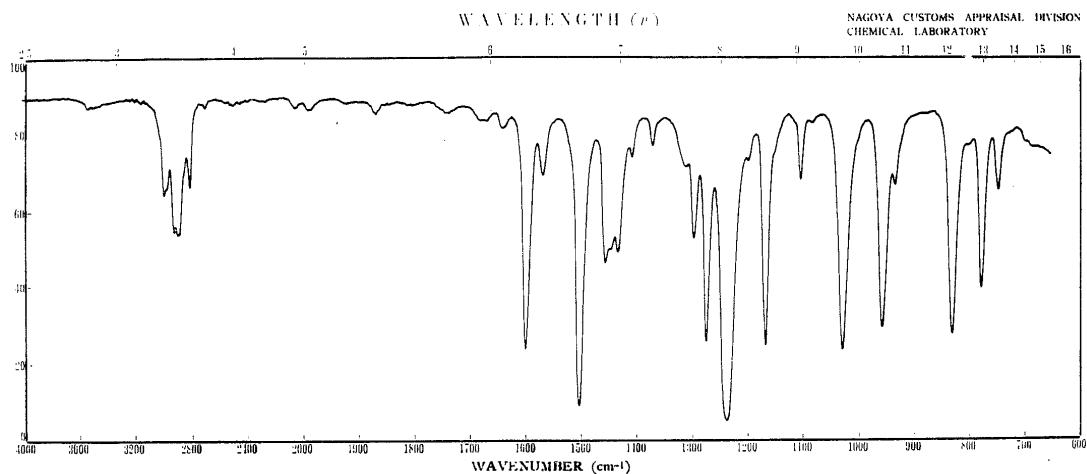


SPECTRUM No.	SAMPLE No. 36	INSTRUMENT JASCO IR-S	ORIGIN	SG $^{22}_4 0 \frac{9269}{1} [\alpha]_D^{13} - 163^\circ$
DATE Feb. 1965	Spearmint oil	STATE Liquid film	MAKER	$n_D^{20} 1 \frac{4845}{1}$

3510, 3330, 3082, 2965, 2930, 2888, 2850, 1712, 1677, 1647,
 1451, 1436, 1369, 1246, 1142, 1111, 1058, 995, 960, 893, 800,
 702.

Fig 39

主要吸収は Carvone (27) によるもの。

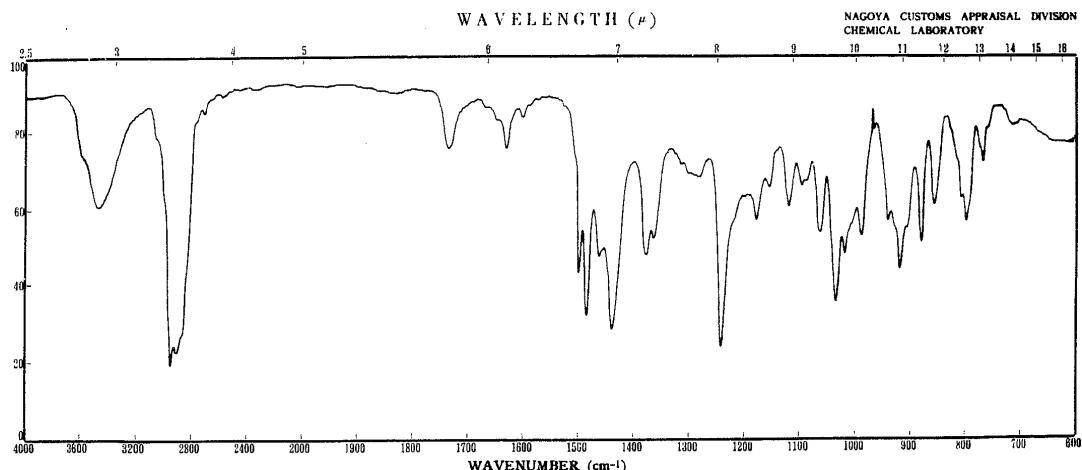


SPECTRUM NO.	SAMPLE NO. 27	INSTRUMENT JASCO IR-S	ORIGIN	$\text{SG}^{1.9}_4 0.9867 [\alpha]_D \quad 0^\circ$
DATE Oct. 1964	Staranise oil	STATE Liquid film	MAKER	$n^{20}_D 1.5565$

3022, 2953, 2927, 2912, 2828, 1608, 1576, 1510, 1466, 1455,
1444, 1418, 1378, 1324, 1306, 1290, 1253, 1208, 1175, 1112,
1036, 963, 942, 838, 792, 755.

Fig 40

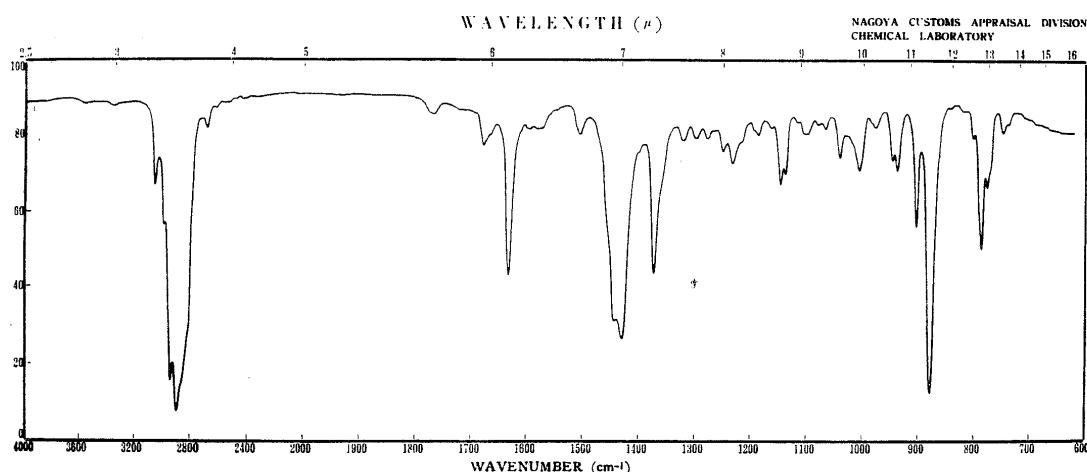
主要吸収は何れも Anethole によるもの。
Anise oil, Fennel oil (第3図, 第16図) 参照。



SPECTRUM No.	SAMPLE No. 30	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{2}{4} 0.9355$ $[\alpha] \frac{13}{D} +162^\circ$
DATE Aug. 1964	Sho-Gyu oil	STATE Liquid film	MAKER	n $\frac{2}{D} 1.4825$

3470, 2965, 2930, 2880, 1745, 1643, 1612, 1507, 1493, 1469,
 1445, 1380, 1366, 1246, 1185, 1160, 1124, 1101, 1070, 1041,
 1026, 995, 946, 926, 887, 863, 804, 774.

Fig 41



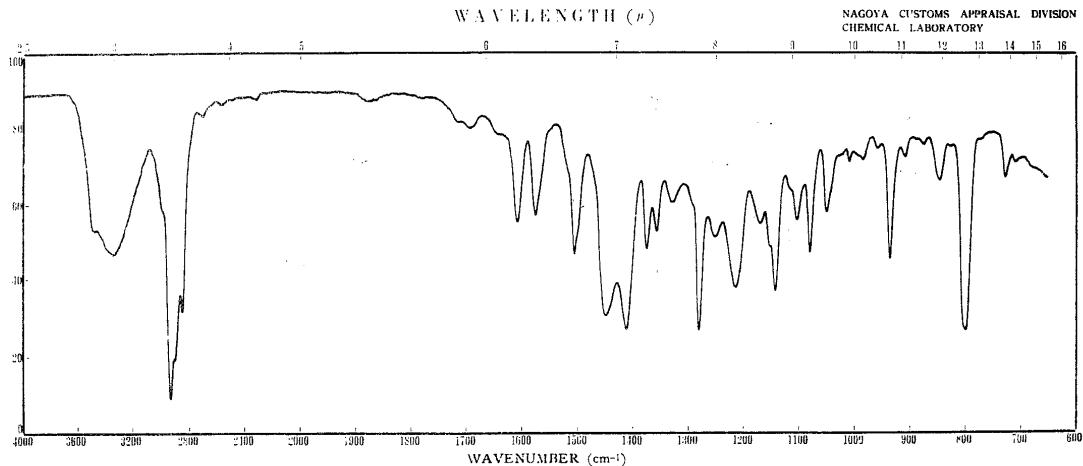
SPECTRUM No.	SAMPLE No. 58	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{1}{4} 0.8568$ $[\alpha] \frac{12}{D} +850^\circ$
DATE Feb. 1965	Tangerine oil	STATE Liquid film	MAKER Polak's Frutal	n $\frac{2}{D} 1.4700$

3065, 3008, 2965, 2912, 2848, 2828, 1692, 1647, 1515, 1454,
 1437, 1376, 1260, 1240, 1197, 1155, 1146, 1050, 1015, 956,
 947, 915, 888, 798, 788, 758.

Fig 42

D - Limonene (1155) の吸収に同じ。

Lemon oil (第 23 図) 参照。

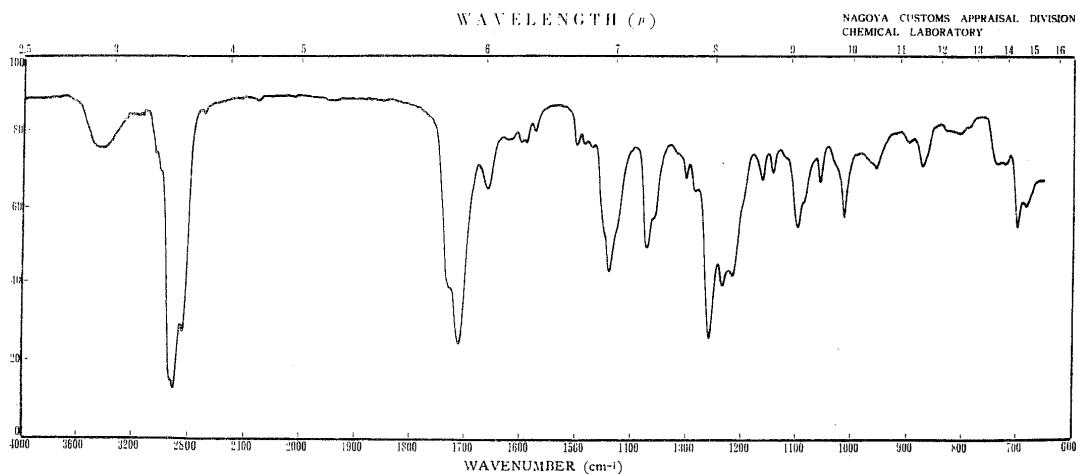


SPECTRUM #	SAMPLE # 28	INSTRUMENT JASCO IR-S	ORIGIN	SG $^{19}_4$ 0.9313 [α] $^{13}_D$ -1 $^{23}_D$
DATE Oct. 1964	Thyme oil	STATE Liquid film	MAKER	n $^{20}_D$ 1.5010

3400, 3015, 2963, 2925, 2870, 1711, 1622, 1585, 1517, 1461,
1422, 1383, 1366, 1343, 1291, 1265, 1225, 1154, 1114, 1089,
1061, 946, 858, 810, 739, 721.

Fig 43

主要吸収は Carvacrol (407), Thymol (786) によるもの。

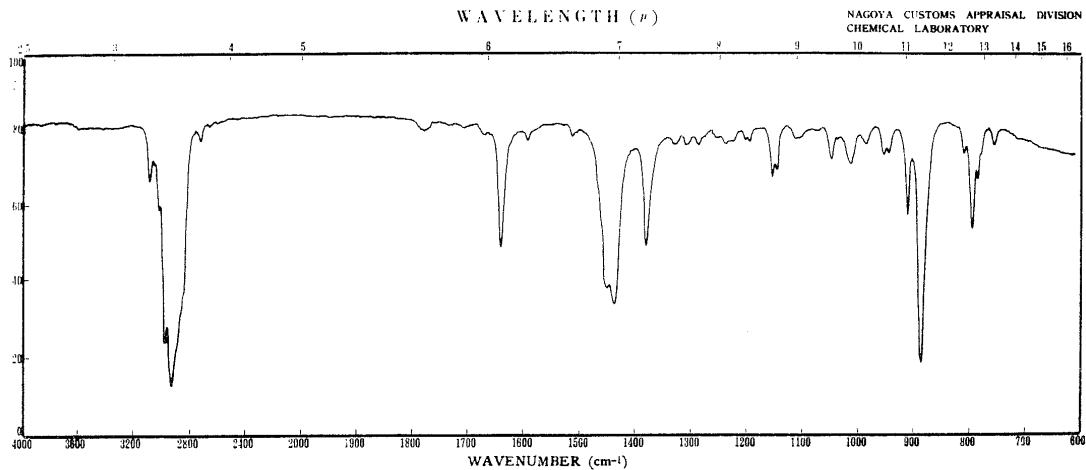


SPECTRUM No.	SAMPLE No. 29	INSTRUMENT JASCO IR-S	ORIGIN	SG $\frac{1}{4} 0 \frac{9844}{13}$ [α] $\frac{1}{D} 25^{\circ}$
DATE Nov. 1964	Ylang-ylang oil	STATE Liquid film	MAKER	n $\frac{2}{D} 1 \frac{5155}{1}$

3480, 2955, 2925, 2870, 1740, 1724, 1626, 1617, 1610, 1588,
 1516, 1500, 1490, 1453, 1385, 1370, 1316, 1300, 1273, 1250,
 1230, 1176, 1157, 1110, 1070, 1027, 969, 886, 749, 734, 711,
 697.

Fig 44

Geraniol (1773), Linalool (19), Linalyl acetate (1778), Benzyl alcohol (25) 等の混合による吸収。
 Cananga oil (第7図) 参照。



SPECTRUM No.	SAMPLE No. 50	INSTRUMENT JASCO IR-S	ORIGIN Japan	SG $\frac{1}{4} 0 \frac{8500}{10}$ [α] $\frac{1}{D} +89\frac{4}{5}$
DATE Dec. 1964	Yuzu oil	STATE Liquid film	MAKER	n $\frac{2}{D} 1 \frac{4750}{1}$

3065, 3008, 2965, 2915, 1781, 1710, 1677, 1647, 1597, 1517,
 1454, 1437, 1378, 1331, 1359, 1285, 1252, 1240, 1225, 1197,
 1155, 1146, 1114, 1107, 1075, 1050, 1015, 988, 956, 948, 915,
 888, 814, 798, 788, 758.

Fig 45

D - Limonene (1155) の吸収に同じ。

Lemon oil (第23図) 参照。

4 結 果

植物精油はテルペノン系化合物を主体とした芳香成分の混合物であるが、一般には各精油とも主成分、混合割合が異なるため、それぞれ特有の吸収が得られた。物理恒数の測定、化学的分析方法とあわせ有効な確認手段であると思われる。

ただ主成分が同じ精油、例へばレモン油、オレンジ油、マンダリン油、タンジェリン油及びゆづ油、あるいはア

ニス油とスター・アニス油等は殆んど同じスペクトルを与えるため赤外線吸収スペクトルだけから同一性を確認することは不可能である。従ってこれらについては物理恒数の測定、クロマトグラフィーによる微量成分の分離、定量等個々の精油について更に研究しなければならない。

最後に本実験をおこなうにあたり直接御指導いただいた名古屋大学教授平田義正博士はじめ研究室の方々、試料の入手に御尽力戴いた高砂香料 KK 平塚工場、工務課長、伴元雄氏、横浜税関税鑑査官 三木善夫氏及び名古屋税關分析官 宇治橋康則氏に対し厚く御礼申し上げる次第である。

A Rapid Analysis of Essential oils by Infrared Spectroscopy

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Usually a large amount of chemical informations and a wide experience in analytical technique are required to identify and appraise many essential oils found in nature. Until recently, their analyses have been performed by the laborious chemical studies and by the measurement of several physical constants. Since it seems to be quite promising to apply the infrared spectroscopy for this purpose, the spectra of about thirty typical essential oils are recorded in the present study. Other physical properties are also examined and tabulated for comparison.

The samples used in this experiment are those listed in the Japanese Customs Tariff Schedule No.3301. Most of the samples were offered by Takasago Perfumery Co.,Ltd.in Japan. Several extracted oils from plants, and the imported materials were also used.

It was found that each of the sample showed a characteristic spectrum and different physical constants and therefore the measurement of the infrared spectrum together with a few other additional data enable one to identify the nature of a given essential oil. The procedure is simple and the result is excellent. However, a very much similar spectrum was observed with some of the samples such as lemon oil, orange oil, mandarin oil, tangerine oil, and yuzu oil, the principal component of which is known to be D-Limonene, and their characterizations were not possible from the spectral measurement alone. This is also the case between star anise oil and anise oil. For those samples, some other convenient tools for separation, like as gas-chromatography or thinlayer chromatography, will have to be examined, and the detection of their components will be of importance to afford accurate and reliable results.

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