CLXXXIX.—*Contribution to Our Knowledge of the Semicarbazones. Part V. Semicarbazones of Benzaldehyde and Some of its Substitution Products.*

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THE results recorded in this paper form a continuation of a series of papers on the semicarbazones (T., 1912, **101**, 1482; 1913, **103**, 377, 1504; 1914, **105**, 2892). The semicarbazones now described are those of benzaldehyde and some of its substitution products.

Several of the compounds have already been prepared, but some are now described for the first time. The study of the compounds has been along two lines, (1) the formation of salts with dry hydrogen chloride, and (2) a spectrographic examination of the semicarbazones. Some interesting results have been obtained, and it is thought that these results are worth being recorded.

Action of Dry Hydrogen Chloride on the Semicarbazones.—When dry hydrogen chloride is passed over the semicarbazones, it is absorbed, and salts are formed which are unstable and readily give up hydrogen chloride on exposure to the air. When the semicarbazone contains one or more hydroxyl or methoxyl groups, two molecular proportions of hydrogen chloride are absorbed and deeply coloured salts are formed. Thus, the semicarbazones of salicylaldehyde, *o*-methoxy-, *p*-hydroxy-, and *p*-methoxy-benzaldehydes, vanillin, and veratraldehyde, which are colourless, absorb two molecular proportions of hydrogen chloride, with the formation of yellow or orange salts. Similarly, piperonalsemicarbazone, which contains a methylene group replacing the hydrogen atoms of two hydroxyl radicles, is white, but combines with two molecular proportions of hydrogen chloride, with the production of an orange-red salt. When the semicarbazone contains a strongly electronegative substituent, for example, chlorine or nitroxyl, only one molecular proportion of hydrogen chloride is absorbed, and the salt which is formed has little or no colour. Thus, the semicarbazones of the three chlorobenzaldehydes are white; they all combine with one molecular proportion of hydrogen chloride, and the salts which are formed have very little colour—only in the case of the para-compound is there a pale yellow colour produced. Again, with the semicarbazones of the three nitrobenzaldehydes, which are yellow, only one molecular proportion of hydrogen chloride is absorbed, and the salts which are formed have lost their original colour; the salts of the ortho- and meta-compounds are almost white, and that of the para-compound is pale pink.

In order to study the effect of the nature of the radicle on the amount of hydrogen chloride which combines with the semicarbazones, the acetyl, benzoyl, and *p*-nitrobenzoyl derivatives of salicylaldehydesemicarbazone were prepared and examined. It was found that the introduction of the acetyl and benzoyl groups does not inhibit the addition of two molecular proportions of hydrogen chloride; the salts formed were coloured. However, the introduction of the nitrobenzoyl group was at once apparent, and only one molecular proportion of hydrogen chloride was absorbed, and the salt had the same colour as the semicarbazone.

No definite result could be obtained in the case of *p*-dimethylaminobenzaldehydesemicarbazone, as the salt fused and showed signs of decomposition. It combined with nearly four molecular proportions of hydrogen chloride.

p-Tolualdehydesemicarbazone combined with more than one and a-half molecular proportions of hydrogen chloride, and the product was yellow. A definite result was not obtained, as the salt sintered badly.

Isomerides.—All these semicarbazones should theoretically exist in two forms:

Evidence was obtained that, in addition to the stable form, small quantities of an unstable form were also produced in certain cases. It was observed during the preparation of the semicarbazones that whilst the bulk of the precipitated compound was white, there was in several cases a yellow substance formed at the same time. It might be supposed that the yellow form was due to the formation of the hydrochloride of the semicarbazone; but this supposition must be ruled out, as it has been found that the coloured salts of the semicarbazones with hydrogen chloride are immediately decomposed by water. Also in the two cases of anisaldehydesemicarbazone and *o*-chlorobenzaldehydesemicarbazone it was possible to isolate in the crystalline state very small quantities of yellow substances melting at a much lower temperature than the stable white forms. As a rule, it was found that repeated crystallisation of the coloured substance give rise only to the colourless form. In the case of *p*-dimethylaminobenzaldehydesemicarbazone, it was found that the compound when first precipitated was deep red, and that repeated crystallisation give rise to the white form only. This red form is not the hydrochloride, which is yellowish-green. In several cases it was attempted to prepare the isomerides by exposure to the action of ultra-violet light, but without success.

Spectrographic Examinations.—All the compounds described in the experimental part have been examined spectrographically in alcoholic solution, in sodium ethoxide, and in concentrated sulphuric acid. (The sulphuric acid used was that sold as being free from arsenic, and was exceedingly diactinic.) The results of this examination are described below.

Benzaldehydesemicarbazone.—The alcoholic solution shows a band in *N*/10,000-solution, with its head at $1/\lambda$ 3500; the addition of sodium ethoxide produces no change in the position of the band, but causes a slight shift towards the red in the upper part of the

curve. In concentrated sulphuric acid there is a deep band in $N/10,000$ -solution at $1/\lambda$ 3300.

p-Tolualdehydesemicarbazone.—The general appearance of the curves is very similar to those found in the case of the preceding compound.

Salicylaldehydesemicarbazone and *o-Methoxybenzaldehydesemicarbazone*.—In solution in alcohol, these two compounds give identical absorption curves, showing two bands in $N/10,000$ -solution at $1/\lambda$ 3150 and $1/\lambda$ 3600 respectively. The curves in concentrated sulphuric acid are also identical and show two bands, one in $N/1000$ -solution at $1/\lambda$ 2600 and the other in $N/10,000$ -solution at $1/\lambda$ 3400. When excess of sodium ethoxide is added to the alcoholic solutions, a difference is found in the absorption spectra of the two compounds. In the former, which contains a hydroxyl group, the effect of the sodium ethoxide is to cause a shift towards the red in the position of one of the bands, which now appear at $1/\lambda$ 2800 and $1/\lambda$ 3600 in $N/10,000$ -solution. This shift in the position of the band does not occur with the second compound, in which the hydrogen of the hydroxyl group is replaced by methyl. This difference in the action of sodium ethoxide on the hydroxy-compound and the corresponding methyl derivative is also observed in the case of other pairs of such compounds.

p-Hydroxybenzaldehydesemicarbazone and *p-Methoxybenzaldehydesemicarbazone* give similar bands in alcohol and in sulphuric acid. In alcohol the band is at $1/\lambda$ 3500 in $N/10,000$ -solution, and in sulphuric acid at $1/\lambda$ 2900 at the same concentration. Sodium ethoxide shifts the position of the band to $1/\lambda$ 3200 in the case of the hydroxy-compound.

Vanillinsemicarbazone, *veratraldehydesemicarbazone*, and *piperonalsemicarbazone* all show two shallow bands in alcoholic solution at $1/\lambda$ 3200 and $1/\lambda$ 3500 in $N/10,000$ -solution. In concentrated sulphuric acid, the three compounds give a deep band at $1/\lambda$ 2800 in $N/10,000$ -solution. The addition of sodium ethoxide to the alcoholic solution causes a change in the position of the band only in the case of the first compound; in the other two compounds there is merely a slight shift to the red in the upper part of the curves.

2-Hydroxy-m-methoxybenzaldehydesemicarbazone and *2:3-dimethoxybenzaldehydesemicarbazone* have similar bands in alcohol and in sulphuric acid. The alcoholic solutions show a band at $1/\lambda$ 3500 in $N/10,000$ -solution, and the sulphuric acid solutions give two bands, one at $1/\lambda$ 2300 in $N/1000$ - and the other at $1/\lambda$ 3200 in $N/10,000$ -solution. The addition of sodium ethoxide to the alcoholic solution causes a change in the case of the hydroxy-

compound only. Two bands are shown, one at $1/\lambda$ 2700 and the other at $1/\lambda$ 3500, both in $N/10,000$ -solution.

The *semicarbazones* of the three *chlorobenzaldehydes* all give very similar absorption curves. In alcohol, all have a band at $1/\lambda$ 3500 in $N/10,000$ -solution. In concentrated sulphuric acid, the ortho- and meta-compounds have a band at $1/\lambda$ 3300 in $N/10,000$ -solution, but the band is not so deep in the meta-compound as in the ortho-compound; the para-compound has a band at $1/\lambda$ 3150, and this band is narrower than in the case of the ortho- and meta-compounds. The addition of sodium ethoxide to the alcoholic solution does not cause a change in the position of the band, but shifts the upper part of the curves a little towards the red.

The Semicarbazones of the Three Nitrobenzaldehydes.—The ortho- and meta-compounds in alcoholic solution show one band at $1/\lambda$ 3500 in $N/10,000$ -solution, whilst the para-compound has a band at $1/\lambda$ 3100. The addition of sodium ethoxide causes a large shift in the position of the upper parts of the curves in $N/1000$ -solution, but has little effect on the position of the bands. It was found that there was a deviation from Beer's law. The solutions on concentrated sulphuric acid were without visible colour; the ortho-compound has a shallow band at $1/\lambda$ 3200; the meta-compound shows the beginning of a band, and then a cut-out; the para-compound gives a well-defined band at $1/\lambda$ 3600; in the last case there is a displacement towards the ultra-violet end of the spectrum.

p-Dimethylaminobenzaldehydesemicarbazone.—This compound revealed some interesting results. In alcoholic solution, the position of the band is at $1/\lambda$ 3100 and in sulphuric acid at $1/\lambda$ 3500 in $N/10,000$ -solution. The addition of sodium ethoxide to the alcoholic solution does not produce any change in the curve. The position of these bands is the same as those of *p*-hydroxybenzaldehydesemicarbazone in alcohol plus sodium ethoxide and in alcohol respectively. Evidently the strongly electropositive group, NMe_2 , has the same effect on the position of the band as the group ONa ; the sulphuric acid neutralises the effect of the dimethylamino-group, and the position of the band is then the same as that of *p*-hydroxybenzaldehydesemicarbazone in alcohol.

The acetyl-, benzoyl-, and *p*-nitrobenzoyl derivatives of salicylaldehydesemicarbazone are similar to one another; they all give one band in alcoholic solution at $1/\lambda$ 3500 in $N/10,000$ -solution; the bands given in sodium ethoxide solution are the same as those of salicylaldehydesemicarbazone in sodium ethoxide. The addition

of sodium ethoxide to the alcoholic solution thus causes hydrolysis and eliminates the acyl group.

General Conclusions.

With two exceptions, all the compounds examined showed a band in $N/10,000$ -alcoholic solution at about $1/\lambda$ 3500; the exceptions are *p*-dimethylaminobenzaldehydesemicarbazone and *p*-nitrobenzaldehydesemicarbazone.

The results show that when there is a hydroxyl group present in the compound, the addition of sodium ethoxide causes a shift in the position of the absorption band towards the red. This is found in the case of the semicarbazones of *o*- and *p*-hydroxybenzaldehyde, vanillin, and 2-hydroxy-*m*-methoxybenzaldehyde. When the hydrogen of the hydroxyl group is displaced by methyl, the addition of sodium ethoxide does not cause this change in the position of the band; for example, the curves for the semicarbazones of *o*- and *p*-methoxybenzaldehyde, veratraldehyde, etc., in sodium ethoxide are the same as in alcohol.

The absorption curve for *p*-dimethylaminobenzaldehydesemicarbazone in alcoholic solution is the same as that of *p*-hydroxybenzaldehydesemicarbazone in sodium ethoxide.

In the case of the acyl derivatives of salicylaldehydesemicarbazone, the action of sodium ethoxide is to cause hydrolysis.

The curves obtained for the semicarbazones of salicylaldehyde and its methoxy-derivative, and also for 2-hydroxy-*m*-methoxybenzaldehyde and its methoxy-derivative, all show a band in concentrated sulphuric acid at about $1/\lambda$ 2600 which is wanting in the other curves. In these four cases, the hydroxyl or methoxyl group is in the ortho-position with respect to the semicarbazone group.

EXPERIMENTAL.

The semicarbazones used in this investigation were all prepared in the usual way by adding an aqueous solution of the requisite quantities of semicarbazide hydrochloride and potassium acetate to an alcoholic solution of the aldehyde; after allowing to remain overnight, the product was collected, washed with water, and purified by crystallisation from alcohol or other solvent until a constant melting point was obtained.

The *hydrochlorides* were prepared by passing dry hydrogen chloride over the semicarbazone contained in a U-tube until there was no further increase in weight on continued passage of the gas. The results were calculated in the manner indicated by Wilson, Heilbron and Sutherland (T., 1914, 105, 2895).

p-Tolylaldehydesemicarbazone Hydrochloride.

0.1405 semicarbazone gave 0.1850 hydrochloride. HCl added = 24.05.

$C_9H_{11}ON_3, 1\frac{1}{2}HCl$ requires HCl added = 23.6 per cent.

The salt was yellow, and on exposure to air it rapidly lost hydrogen chloride. No definite result could be obtained, owing to the sintering of the product during the addition of the hydrogen chloride.

Salicylaldehydesemicarbazone Dihydrochloride.

0.6219 semicarbazone gave 0.8860 hydrochloride. HCl added = 29.8.

$C_8H_9O_2N_3, 2HCl$ requires HCl added = 28.9 per cent.

The salt was yellow, and unstable in air.

Monosulphate.—This was prepared by stirring the semicarbazone with cold, concentrated sulphuric acid, the whole being cooled by means of ice. Dry ether was then added, and the solid obtained was collected, washed free from excess of acid with dry ether, and dried on a porous tile. The analysis was carried out by treating a known quantity with excess of *N*/20-sodium hydroxide, heating on the water-bath for ten minutes, and titrating the residual alkali with *N*/20-acid:

0.0900 required 12.7 c.c. *N*/20-NaOH. $H_2SO_4 = 34.57$.

$C_8H_9O_2N_3, H_2SO_4$ requires $H_2SO_4 = 35.4$ per cent.

The straw-yellow salt decomposed at 150° , and was fairly stable in air.

o-Methoxybenzaldehydesemicarbazone,

This compound was obtained in colourless needles, melting and decomposing at 215° :

0.1526 gave 28.2 c.c. N_2 at 17.5° and 767 mm. $N = 21.58$.

$C_9H_{11}O_2N_3$ requires $N = 21.76$ per cent.

Dihydrochloride.

0.3738 semicarbazone gave 0.5132 hydrochloride. HCl added = 27.2.

$C_9H_{11}O_2N_3, 2HCl$ requires HCl added = 27.4 per cent.

The dark orange salt was fairly stable in air.

p-Hydroxybenzaldehydesemicarbazone.

Borsche and Bolser (*Ber.*, 1901, **34**, 2098) described this compound as a yellow, crystalline powder, melting at 223—225°; Knöpfer (*Monatsh.*, 1910, **31**, 72) stated that it is white and melts at 218°.

When the components were mixed, a precipitate began to form immediately, the bulk of which was colourless, but part of it was yellow. The addition of water to the filtrate gave a further precipitate of a yellow substance. These two precipitates were worked up separately, but crystallisation of each from boiling alcohol gave only colourless needles, which melted and decomposed at 222°. If the yellow substance is the theoretically possible isomeride, it is unstable, for on crystallisation it passes into the stable, colourless form.

Dihydrochloride.

0.2485 semicarbazone gave 0.3458 hydrochloride. HCl added = 28.12.

$C_8H_9O_2N_3 \cdot 2HCl$ requires HCl added = 28.9 per cent.
The salt is yellow and unstable.

Monosulphate.

0.0880 required 12.5 c.c. $N/20-NaOH$. $H_2SO_4 = 34.8$.

$C_8H_9O_2N_3 \cdot H_2SO_4$ requires $H_2SO_4 = 35.4$ per cent.
The salt is yellow.

p-Methoxybenzaldehydesemicarbazone.

Walbaum (*J. pr. Chem.*, 1903, [ii], **68**, 247) and Knöpfer (*loc. cit.*) give the melting point as 203—204°. As in the case of the previous compound, we obtained a mixture of colourless and yellow forms. By means of acetone, we were able to separate the yellow form from the colourless, the yellow modification being quite soluble in acetone, whilst the colourless form is only sparingly soluble in acetone. The yellow form was obtained in small, transparent, yellow prisms, melting sharply at 168°, but the quantity was too small to allow of further investigation. After all the yellow form had been removed, the residue was crystallised from boiling alcohol, and obtained in colourless needles, melting and decomposing at 209°:

0.1616 gave 20.3 c.c. N_2 at 19° and 766 mm. $N = 21.73$.

$C_9H_{11}O_2N_3$ requires $N = 21.76$ per cent.

Dihydrochloride.

0.1677 semicarbazone gave 0.2324 hydrochloride. HCl added = 27.84.

$C_9H_{11}O_2N_3 \cdot 2HCl$ requires HCl added = 27.4 per cent.

The orange-yellow salt was unstable in air. It fused during its preparation.

Monosulphate.

0.1033 required 14 c.c. *N*/20-NaOH. $H_2SO_4 = 33.2$.

$C_9H_{11}O_2N_3 \cdot H_2SO_4$ requires $H_2SO_4 = 33.7$ per cent.

The mustard-yellow salt decomposed at 152° , and was stable in air.

An experiment was made with a view to ascertain if the sulphate would absorb hydrogen chloride. After passing the gas for four days over a weighed quantity of the sulphate in a U-tube, there was no increase in weight; the colour had not altered, and the decomposition point remained at 152° .

Vanillinsemicarbazone Dihydrochloride.

0.1721 semicarbazone gave 0.2320 hydrochloride. HCl added = 25.82.

$C_9H_{11}O_3N_3 \cdot 2HCl$ requires HCl added = 25.88 per cent.

The orange-yellow salt was very unstable in air; it began to sinter at 40° , and decomposed at 78° . When placed on a porous tile and exposed to air, it melted to a dark red liquid, and then dried to a pale yellow solid.

Veratraldehydesemicarbazone Dihydrochloride.

0.2666 semicarbazone gave 0.3549 hydrochloride. HCl added = 24.88.

$C_{10}H_{13}O_3N_3 \cdot 2HCl$ requires HCl added = 24.66 per cent.

The dark, orange-yellow salt was unstable in air. It began to melt at 90° , and decomposed at 130° .

Piperonalsemicarbazone Dihydrochloride.

0.1084 semicarbazone gave 0.1477 hydrochloride. HCl added = 26.61.

$C_9H_9O_3N_3 \cdot 2HCl$ requires HCl added = 26.06 per cent.

The deep orange-red salt began to decompose at 110° . It gave off hydrogen chloride on exposure to air, and turned yellow.

2-Hydroxy-m-methoxybenzaldehydesemicarbazone.

This compound forms colourless needles, melting and decomposing at 225°:

0.140 gave 23.8 c.c. N₂ at 12° and 758 mm. N=20.13.

C₉H₁₁O₃N₃ requires N=20.09 per cent.

Dihydrochloride.

0.1092 semicarbazone gave 0.1468 hydrochloride. HCl added=25.82.

C₉H₁₁O₃N₃.2HCl requires HCl added=25.88 per cent.

The yellow salt was unstable in air, and melted and decomposed at 158°

2:3-Dimethoxybenzaldehydesemicarbazone.

This formed white needles, melting and decomposing at 231°:

0.1535 gave 24.6 c.c. N₂ at 13° and 758 mm. N=18.89.

C₁₀H₁₃O₃N₃ requires N=18.83 per cent.

Dihydrochloride.

0.2064 semicarbazone gave 0.2683 hydrochloride. HCl added=23.06.

C₁₀H₁₃O₃N₃.2HCl requires HCl added=24.66 per cent.

The dirty yellow salt sintered during its preparation.

Chlorobenzaldehydesemicarbazones.

These semicarbazones have been described by Law and Perkin (T., 1908, **93**, 1636), who state that the compounds are insoluble in all organic solvents except pyridine and glacial acetic acid. We crystallised them from boiling methyl alcohol, in which they are sparingly soluble; we also find slight differences in the melting points:

	M.p. L. and P.	M.p. H. and H.
Ortho-	225-226°	229-230°
Meta-	228°	230°
Para-	230°	232-233°

We obtained the ortho- and meta-compounds as white, feathery leaflets, and the para- in white, felted needles. In the case of the ortho-compound, by solution in acetone we were able to isolate a small quantity of a yellow form, which occurred as yellow, transparent prisms, melting at 146°. The amount obtained was not sufficient to allow of further examination.

Hydrochlorides.

Ortho-, 0.2142 semicarbazone gave 0.2560 hydrochloride. HCl added = 16.32.

The cream-coloured salt was unstable in air, and decomposed at 203°.

Meta-, 0.1698 semicarbazone gave 0.2015 hydrochloride. HCl added = 15.73.

The colourless salt was unstable, and decomposed at 198°.

Para-, 0.2698 semicarbazone gave 0.3217 hydrochloride. HCl added = 16.13.

$C_8H_8ON_3Cl$, HCl requires HCl added = 15.6 per cent.

The pale yellow salt was unstable, and decomposed at 182°.

Nitrobenzaldehydesemicarbazones.

Thiele and Stange (*Annalen*, 1894, **283**, 25) have described these compounds. The melting point of the para-compound was found to be 211°, whereas the above authors give 221°. (Found, N = 27.15. Calc., N = 26.92 per cent.)

Hydrochlorides.

Ortho-, 0.1066 semicarbazone gave 0.1269 hydrochloride. HCl added = 14.4.

The cream-coloured salt was unstable in air, in which the original colour of the semicarbazone was soon regained. It decomposed at 212°.

Meta-, 0.1092 semicarbazone gave 0.1284 hydrochloride. HCl added = 14.95.

The cream-coloured salt was unstable in air, and decomposed at 222°.

Para-, 0.1434 semicarbazone gave 0.1680 hydrochloride. HCl added = 14.64.

$C_8H_8O_3N_4$, HCl requires HCl added = 14.92 per cent.

The pink salt was fairly stable in air, and was not decomposed at 275°.

o-Acetoxybenzaldehydesemicarbazone.

This was crystallised from acetone, and obtained as a colourless, granular powder, melting at 167°:

0.1318 gave 21.3 c.c. N_2 at 10° and 745 mm. N = 18.89.

$C_{10}H_{11}O_3N_3$ requires N = 19.00 per cent.

Dihydrochloride.

0.1058 semicarbazone gave 0.1408 hydrochloride. HCl added = 24.8.

$C_{10}H_{11}O_3N_3 \cdot 2HCl$ requires HCl added = 24.9 per cent.

The dark yellow salt was unstable in air. It sintered during its preparation.

o-Benzoyloxybenzaldehydesemicarbazone.

This crystallised from alcohol in colourless needles, melting and decomposing at 195—196°:

0.1500 gave 18.6 c.c. N_2 at 10° and 756 mm. $N = 14.76$.

$C_{15}H_{13}O_3N_3$ requires $N = 14.84$ per cent.

Dihydrochloride.

0.1801 semicarbazone gave 0.2280 hydrochloride. HCl added = 21.01.

$C_{15}H_{13}O_3N_3 \cdot 2HCl$ requires HCl added = 20.5 per cent.

The cream-coloured salt was unstable in air.

2-p-Nitrobenzoyloxybenzaldehyde.

This was prepared by the action of *p*-nitrobenzoylchloride on salicylaldehyde in pyridine solution. The compound after purification formed pale yellow, transparent leaflets, melting at 128°:

0.1985 gave 8.7 c.c. N_2 at 12° and 736 mm. $N = 5.04$.

$C_{14}H_9O_5N$ requires $N = 5.16$ per cent.

The semicarbazone crystallised from alcohol in pale yellow needles, melting and decomposing at 218°:

0.1384 gave 20.0 c.c. N_2 at 11° and 753 mm. $N = 17.11$.

$C_{15}H_{12}O_5N_4$ requires $N = 17.07$ per cent.

Monohydrochloride.

0.1416 semicarbazone gave 0.1576 hydrochloride. HCl added = 10.15.

$C_{15}H_{12}O_5N_4 \cdot HCl$ requires HCl added = 10.01 per cent.

There was no change in the colour on adding hydrogen chloride. The salt was unstable in air.

p-Dimethylaminobenzaldehydesemicarbazone Hydrochloride.

0.0806 semicarbazone gave 0.1335 hydrochloride. HCl added = 39.6.

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0.0926 semicarbazone gave 0.1503 hydrochloride. HCl added = 38.4.

$C_{10}H_{14}ON_4 \cdot 3HCl$ requires HCl added = 34.7 per cent.

$C_{10}H_{14}ON_4 \cdot 4HCl$ „ HCl „ = 41.4 „ „

No definite result could be obtained, as the additive product was fused and showed signs of decomposition. It was greenish-yellow, and very unstable.

The results obtained for the formation of the hydrochlorides are collected in the following table:

Semicarbazone investigated.	Molecules of HCl added.	Colour of additive product.	Stability of additive product.
Benzaldehyde	1	grey	fairly stable
<i>p</i> -Tolualdehyde	{ More than 1. No definite result.	{ yellow	{ unstable
Salicylaldehyde	2	„	„
<i>o</i> -Methoxybenzaldehyde	2	orange	fairly stable.
<i>p</i> -Hydroxybenzaldehyde	2	yellow	unstable.
<i>p</i> -Methoxybenzaldehyde	2	orange-yellow	„
Vanillin	2	„	very unstable.
Veratraldehyde	2	dark orange	unstable.
Piperonal	2	orange-red	„
2-Hydroxy- <i>m</i> -methoxybenzaldehyde	2	yellow	„
2 : 3-Dimethoxybenzaldehyde	2	„	„
<i>o</i> -Chlorobenzaldehyde	1	cream	„
<i>m</i> -Chlorobenzaldehyde	1	white	„
<i>p</i> -Chlorobenzaldehyde	1	pale yellow	„
<i>o</i> -Nitrobenzaldehyde	1	cream	„
<i>m</i> -Nitrobenzaldehyde	1	„	„
<i>p</i> -Nitrobenzaldehyde	1	pink	fairly stable.
<i>o</i> -Acetoxybenzaldehyde	2	dark yellow	unstable.
<i>o</i> -Benzoyloxybenzaldehyde	2	cream	„
2- <i>p</i> -Nitrobenzoyloxybenzaldehyde.	1	No change in colour	„
<i>p</i> -Dimethylaminobenzaldehyde ...	{ More than 3 Indefinite	{ yellowish- green	{ very unstable.

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