THE CONDENSATION OF ALDEHYDES WITH AMIDES

Part VI. The Condensations of *o*-, *m*- and *p*-Methoxybenzaldehydes

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CONDENSATIONS of *o*-, *m*- and *p*-hydroxybenzaldehydes with a few aliphatic and aromatic acid amides have already been reported.[1,2,3] In the present paper are described the condensations of the same amides with the three corresponding methyl ethers of the three hydroxyaldehydes.

The results have been somewhat different from what had been expected. In the first instance, under the experimental conditions employed, formamide gave little or no condensation product, in spite of repeated attempts under different temperatures and in the presence as well as in the absence of an organic base. Of the three hydroxybenzaldehydes, the *m*-aldehyde could not be condensed with this amide,[2] the *para*-isomer had condensed to give an yield of 63%,[3] and salicylaldehyde had actually given a quantitative yield.[1]

Secondly, while all the three hydroxybenzaldehydes had formed with the amides compounds of the type of unsaturated benzylidene-monoamides, the products of condensation of the methoxybenzaldehydes were all benzylidene-bis(or di-)amides, that showed no sign of unsaturation.

The yields in the present case were between 37% and 57%, and were slightly better than those of *m*-hydroxybenzylidene-amides, but were not so good as those of the corresponding *o*- and *p*-derivatives.

The presence of the organic base in a trace made little improvement in the yields.

The methoxy-benzylidene-bisamides, though not obtained in very high yields, were on the whole easily purified, gave good melting points, and had the chemical character that is expected of such compounds. In several cases it was possible to determine molecular weights by Rast's method and these values obtained were in conformity with the expected values of the bis-compounds.

Experimental

o-*Methoxybenzylidene-bisacetamide.*—3·4 g. *o*-methoxybenzaldehyde, 4·5 g. acetamide and 0·22 g. pyridine (1 : 3: 0·15 mol.) were heated on an oil-bath at 130° for 4 hours. The mass fused at about 100° and began to give off vapours of water. The cold solid mass was found to contain very appreciable amounts of the unreacted aldehyde, which was removed by extractions with ether. The remaining solid was crushed and well digested with water to remove acetamide, and filtered off. On recrystallisation from hot alcohol, the bisacetamide came out in milk-white needles, m.p. 223°. Yield 2·2 g. or 37% of theory.

The *o*-methoxybenzaldehyde and acetamide, in the same amounts as above, but without pyridine or any other condensing agent, were also heated for 8 hours at 100°, the product recovered as above and the yield was found to be 2·8 g. or 47%. In another experiment, the heating was carried out, in the absence of a condensing agent at 130–40° for 4 hours, when the yield was 2·9 g. or 49%. (Found N = 11·92% : the bisamide $C_{12}H_{16}O_3N_2$ requires 11·87 %.)

o-*Methoxybenzylidene-bispropionamide.*—3·4 g. *o*-methoxybenzaldehyde and 3·6 g. propionamide (1 : 2 mol.) were heated alone on an oil-bath at 110–15° for 4 hours, and the product taken out as before. Recrystallised from alcohol or acetone, the white silky needles weighed 2·5 g. (38% yield), and melted at 196–97°. (Found N = 10·88% : the bisamide $C_{14}H_{24}O_3N_2$ requires 10·60%.)

o-*Methoxybenzylidene-bisbenzamide.*—3·4 g. *o*-methoxybenzaldehyde and 6 g. benzamide (1 : 2 mol.) were heated on an oil-bath at 130–35° for 4 hours. The product was separated as before, recrystallised from hot alcohol or acetone, and came out in white micro needles melting at 233°. The yield was 5·2 g. or about 58%. (Found N = 7·97% : the bisamide $C_{22}H_{20}O_3N_2$ requires N = 7·78%.) Molecular weight, Rast's method—Found : 367·6 and 359·8, Calc. 360.

o-*Methoxybenzylidene-bisphenylacetamide.*—1·7 g. of *o*-methoxybenzaldehyde and 3·4 g. of phenylacetamide (1/80th mol. 1 : 2 mol. proportion) were heated together as usual for 4 hours at 130–40°. The product, taken out as before and recrystallised from hot dilute alcohol or acetone, came out in white silky needles, melting at 197°, and weighing 2·7 g. : yield = 55·7%. (Found N = 7·33% ; the bisamide $C_{24}H_{24}O_3N_2$ requires 7·22%.)

Condensation of o-*methoxybenzaldehyde with formamide*—was attempted under a variety of conditions, but in all cases the aldehyde was recovered

unchanged and some resin was obtained from which no definite product could be separated.

m-*Methoxybenzylidene-bisacetamide.*—Although acetamide was not found to undergo condensation with *m*-hydroxybenzaldehyde,[2] it combined readily with its methyl ether. 3·4 g. *m*-methoxybenzaldehyde and 4·5 g. acetamide (1 : 3 mol. proportion) were heated on an oil-bath at 115–20° for 4 hours, and the *m*-methoxy benzylidene-bisacetamide was taken out in the usual way. It could be recrystallised from hot water, or better, from hot alcohol or acetone. It came out in white silky needles, weighed 3·2 g. (yield = 54%) and melted at 206°. (Found: N = 11·88%; the bisacetamide $C_{12}H_{16}O_3N_2$ requires 11·87%.)

m-*Methoxybenzylidene-bispropionamide.*—3·4 g. of the *m*-methoxybenzaldehyde and 3·6 g. of propionamide (1 : 2 mol.) were heated at 110–15° for 4 hours, the product separated as usual and recrystallised from hot alcohol or acetone. It weighed 3·4 g. (yield = 51·5%), m.p. 201°. (Found: N = 10·92%; the bisamide $C_{14}H_{20}O_3N_2$ requires 10·60%. Molecular weight, found by Rast's method = 263·3, calc. 264.)

m-*Methoxybenzylidene-bisbenzamide.*—3·4 g. *m*-methoxybenzaldehyde and 6 g. benzamide were heated in an oil-bath at 135–40° for 4 hours and the solid separated and purified as usual. The product, recrystallised from hot alcohol or acetone, came out in white needles and weighed 4·7 g. (yield = 52%), m.p. 201–02°. (Found N = 7·86%; the bisamide $C_{22}H_{20}O_3N_2$ requires 7·78%.)

m-*Methoxybenzylidene-bisphenylacetamide.*—1·7 g. of *m*-methoxybenzaldehyde and 3·4 g. of phenylacetamide were heated at 130–40° for 4 hours, and the product separated and purified as usual. Recrystallised from hot alcohol or acetone, it came out in white needles, melted at 181–82°, and weighed 2·5 g. (yield = 51·5%). (Found: N = 7·42%; the bisamide $C_{24}H_{24}N_2O_3$ requires 7·22%.)

From formamide-condensation, unchanged aldehyde and resin were obtained.

p-*Methoxybenzylidene-bisacetamide.*—3·4 g. anisaldehyde and 4·5 g. acetamide (1 : 3 mol.) were heated at 120–25° for 4 hours and the product treated as before. Recrystallised from hot alcohol or acetone, it melted at 230–31° and weighed 3·2 g. (yield = 54%). It was milk-white needled crystals. (Found N = 12·28%: the bisamide $C_{12}H_{16}O_3N_2$ requires 11·87%.)

p-*Methoxybenzylidene-bispropionamide.*—3·4 g. anisaldehyde and 3·6 g. propionamide (1 : 2 mol.) were heated for 4 hours at 110–15°, and the

resulting product separated and purified as usual. It came out in white needles when recrystallised from hot alcohol or acetone, melted at 228° and weighed 2·7 g. (yield = about 40%). (Found: N = 10·77%; the bisamide $C_{14}H_{20}O_3N_2$ requires 10·60%.)

p-*Methoxybenzylidene-bisbenzamide.*—3·4 g. anisaldehyde and 6 g. benzamide (1 : 2 mol.) were heated at 130–35° for 4 hours and the resulting product separated and purified as usual. Recrystallised it came out as white microcrystalline powder, melting at 223–224° and weighing 4·2 g. (yield = about 47%). Found: N = 7·37%; the bisamide $C_{22}H_{20}O_3N_2$ requires 7·78%.)

p-*Methoxybenzylidene-bisphenylacetamide.*—1·7 g. anisaldehyde and 3·4 g. phenylacetamide (1 : 2 mol.) were heated for 4 hours at 130–40°, and the product recovered and purified in the usual way. It came out in white silky crystals, melted at 243°, and weighed 2·7 g. (yield = about 56%). (Found N = 7·407%; the bisamide $C_{24}H_{24}O_3N_2$ requires 7·22%.) Found molecular weight (Rast) = 377·3, calculated = 388. With formamide after several failures, anisaldehyde yielded some pale yellow crystals, melting at about 171°, which might be the condensation product. But its amount was too small for full investigation.

It is hoped to investigate the formamide condensations of several of these aldehydes more thoroughly some other time.

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Summary

Condensations of the three *o*-, *m*- and *p*-methoxybenzaldehydes with certain amides show that formamide does not condense with any of them to an appreciable extent, under the conditions employed, and that the other amides react easily giving corresponding methoxybenzylidenebisamides.

REFERENCES

1. Pandya and Sodhi .. *Proc. Ind. Acad. Sci.*, 1938, (A), **7**, 361.
2. Mehra and Pandya .. *Ibid.*, 1939, (A), **10**, 279.
3. Manzur and Pandya .. *Ibid.*, 1939, (A), **10**, 282.