and a decrease in hepatic aspartate aminotransferase by about 30% were observed, while kidney level of alanine aminotransferase decreased by about 35% in comparison with the controls. The alkaline and acid phosphatases of liver in β-BHC fed rats were reduced by about 45% and 40% respectively, while the kidney enzymes increased by about 125% and 35% respectively. Liver glucose-6-phosphatase activity was decreased by about 30% in β-BHC fed rats while glucose-6-phosphate dehydrogenase activity was increased by as much as 130%. All these effects of β-BHC on the enzyme levels are statistically significant.

In the γ-BHC fed rats, an increase in hepatic alanine aminotransferase by about 50% and a decrease in hepatic aspartate aminotransferase by about 30% were observed, while no significant effects on these enzymes occurred in kidneys. Alkaline and acid phosphatases of liver in γ-BHC fed rats were decreased by about 35% each while only an increase of kidney acid phosphatase by about 40% occurred. Both glucose-6-phosphatase and glucose-6-phosphate dehydrogenase levels of liver in γ-BHC fed rats were increased by about 65% and 40% respectively.

These effects of BHC isomers on liver and kidney enzymes have not been reported. The observed effects on these metabolically important enzymes of liver and kidney imply that both the liver and kidney get affected during the continued intake of β-BHC. Only liver seems to be involved under the experimental conditions in γ-BHC fed animals.

Discipline of Biochemistry and Applied Nutrition,
Central Food Technological Research Institute,
Mysore 570 013, India,
May 17, 1977.

K. SRINIVASAN.
R. RADHAKRISHNAMURTY.

1. Slade, R. E., *Chem. and Indus.*, 1945, p. 314
2. Lehman, A. J., *Assoc. Food and Drug Officials U.S. Quart. Bull.*, 1951, **15**, 122.
3. Davidow, B. and Frawley, J. P., *Proc. Soc. Exptl. Biol. and Med.*, 1951, **76**, 780.
4. McNamara, B. P. and Krop, S., *J. Pharmacol. and Exptl. Therap.*, 1948, **92**, 147.
5. Doisy, E. A. and Bocklage, B. C., *Proc. Soc. Exptl. Biol. and Med.*, 1950, **74**, 613.
6. Sasinovich, L. M., Alekhina, S. M. and Odintsova, I. L., *Vrach Delo.*, 1974, **10**, 133; *Chem. Abs.*, 1975, **82**, 93915.
7. Zakirov, U. B., Volokhvyanskii, E. A. and Kadyrov, U. Z., *Pharmakol. Toksikol.*, 1974, **37**, 593; *Chem. Abs.*, 1975, **82**, 81422.
8. Starek, Andrej, *Med. Pracy.*, 1970, **21**, **554**; *Chem. Abs.*, 1971, **74**, 97226.
9. Kashyap, S. K., Gupta, S. K., Venkatakrishna Bhatt, H. and Shah, M. P., *Ind. J. Med. Res.*, 1976, **64**, 768.
10. Alekhina, S. M., *Toksikol. Pestets. Klin. Otravl.* 1971, **9**, 150; *Chem. Abs.*, 1972, **77**, 148203
11. Bronish, G. A., Rusetskii, V. and Vysotskaya, B., *Gigiena i Toksikol. Novykh Pestitsidov i Klinika Otravlenil.*, 1962, **268**; *Chem. Abs.*, 1964, **60**, 2240.
12. Conney, A. H., *Pharmacol. Revs.*, 1967, **19**, 317.
13. Tonhazy, N. E., White, N. E. and Umbreit, W. W., *Arch. Biochem. Biophys.*, 1950, **28**, 36.
14. Hubscher, G. and West, G. R., *Nature*, 1965, **205**, 799.
15. Harper, A. E., *Methods of Enzymatic Analysis*, Edited by H. V. Bergmeyer, Acad. Press, N.Y. 1963, p. 788.
16. Lohr, G. W. and Waller, H. D., *Ibid.*, 1963, p. 744.
17. Lowry, O. H., Rosenbrough, N. J., Farr, A. L. and Randall, R. J., *J. Biol. Chem.*, 1951, **193**, 265.
18. Snedecor, G. W. and Cochran, *Statistical Methods*, The Iowa State Univ. Press, Iowa, 1967, p. 100.

A NEW SYNTHESIS OF DICOUMAROLS

WITH a general aim to synthesise coumarins containing fused ring systems in 3:4 positions, the condensation reaction between 4-hydroxy coumarins and Schiff's base has been investigated. It has earlier been reported from these laboratories that the Schiff's bases function as potential sources of aldehydes in a number of condensation reactions[1].

In the present investigation, 6-methyl-4-hydroxy coumarin was condensed with the Schiff's base from benzaldehyde and aniline, in acetic acid at room temperature (Fig. 1). The reaction was instantaneous and exothermic. The product obtained had mp 228° C and showed a single spot on T.L.C. in benzene/ethyl acetate (1:1). The compound was soluble in 5% sodium bicarbonate solution indicating that the hydroxy group in 4-position was free and not involved in cyclisation. Further, the compound did not contain nitrogen as indicated by sodium fusion test.

Suspecting it to be of a dicoumarol type, an authentic sample was prepared from 6-methyl-4-hydroxy coumarin following Sullivan *et al*[2]. procedure (m.p. 227° C). Both these compounds were found to be identical in all respects (mmp and superimposable IR). Thus, the compound obtained by the above condensation is 3, 3'-benzylidine bis-6-methyl-4-hydroxy coumarin.

Following this procedure, dicoumarols of the type have been prepared in good yields from the following coumarins namely, simple 4-hydroxy coumarin, 7-methyl-4-hydroxy coumarin, 8-methyl-4-hydroxy coumarin, 6-chloro-4-hydroxy coumarin, 8-chloro-4-hydroxy coumarin, 6-chloro-7-methyl-4-hydroxy coumarin, 6, 8-dichloro-4-hydroxy coumarin. The compounds obtained have been given in Table I along with their mps and the frequency of carbonyl absorption in IR.

TABLE I

Dicoumarols with mp and IR data

Name of the substituent	m.p. C°	% yield	Carbonyl frequency in IR (cm^{-1})
Simple	208[2]	80	1660
6-methyl	228[3]	80	1665
7-methyl	235	80	1660
8-methyl	262	80	1660
6-chloro	220[4]	80	1665
6-chloro-7-methyl	263[5] (lit m.p. 214–6)	75	1665
6, 8-dichloro	255	75	1670

This method does not seem to have been reported earlier for the synthesis of dicoumarols. The reaction conditions are fairly simple and yields are quite good in all cases. This condensation may prove useful for the synthesis of dicoumarols from sensitive aldehydes.

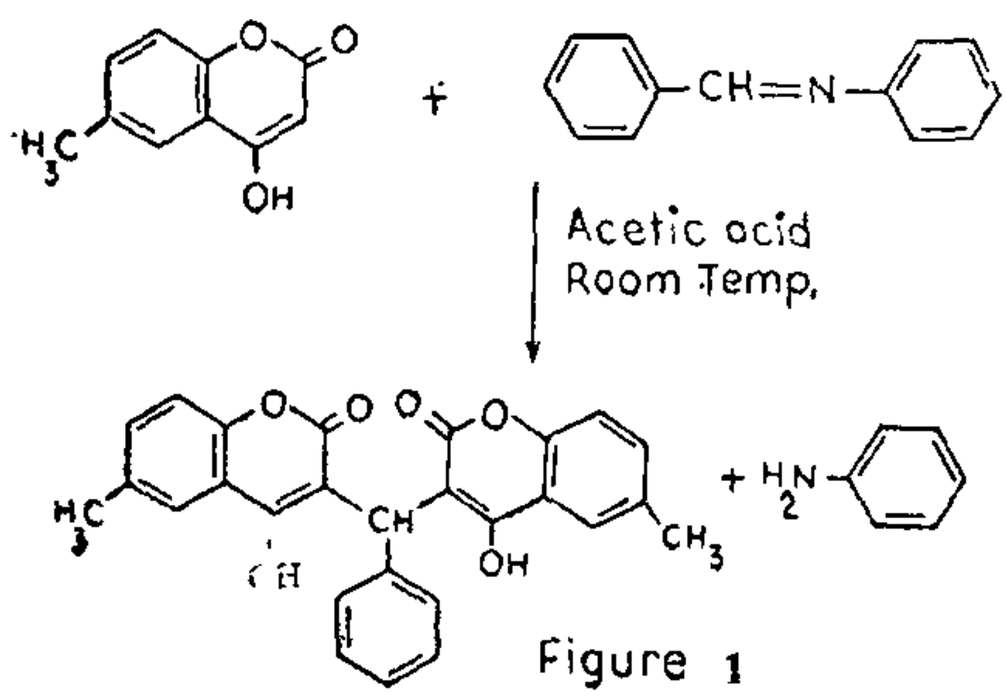

Figure 1

Experimental

General Procedure.—4-hydroxy coumarin (0·02 mole) and Schiff's base (from benzaldehyde and aniline) (0·01 mole) were mixed in acetic acid (20 ml). The clear dark brown solution obtained was shaken well for about 15 minutes at room temperature. A colourless substance was precipitated immediately. This was filtered, dried and recrystallised from methanol as colourless crystals.

One of the authors (K. Srihari) wishes to thank the University Grants Commission for the award of a Junior Research Fellowship.

Dept. of Chemistry,
Osmania University,
Hyderabad 500 007,
July 2, 1977.

K. SRIHARI.
MALLESHWAR DARBARWAR
V. SUNDARAMURTHY.

1. Veeranagaiah, V., Ratnam, C. V. and Subba Rao, N. V., *Indian J. Chem.*, 1972, **10**, 133.
2. Sullivan, W. R., Heubner, C. F., Stahmann, M. A. and Link, K. P., *J. Am. Chem. Soc.*, 1943, **65**, 2288.
3. Josef Klosa; *Arch. Pharm.*, 1956, **289**, 156.
4. —, *Ibid.*, 1956, **289**, 143.
5. —, *Ibid.*, 1956, **289**, 240.

INTERFACIAL TENSION AND PARTICLE SIZE OF NONAQUEOUS EMULSIONS

IN continuation of earlier work on oil-in-oil emulsions[1–3], the present communication describes the effect of temperature on the interfacial tension of oil-oil interface in presence of an emulsifier and an effort has been made to correlate the interfacial tension with the mean particle size and the stability of the resulting emulsions.

Monochlorobenzene and ethylene glycol were employed as the two nonaqueous phases and the surfactants used were (*a*) polyoxyethylene sorbitan monostearate (Tween 60; KL), (*b*) polyoxyethylene sorbitan monooleate (Tween 80; KL), and (*c*) polyoxyethylene sorbitan monolaurate (Tween 20; KL). The oil-in-oil emulsions were prepared with 1:1 phase ratio by volume and 0·1% concentration of nonionic surfactant (*w/v* % of emulsion). The mixtures were emulsified with the help of Braun emulsator.

The interfacial tension of monochlorobenzene-ethylene glycol interface with the surfactant was determined by the drop volume method[4]. Three or more runs were made for each measurement. The interfacial tension ($O_1\ \gamma\ O_2$) at the oil (O_1)-oil (O_2) interface in presence of surfactant was calculated from the expression.

$$_{o_1}\gamma_{o_2} = \frac{v\,(\rho_1 - \rho_2)g}{2\pi r\phi(r/v^{1/3})} = \left[\frac{v\,(\rho_1 - \rho_2)g}{r}\right] F \qquad (1)$$

where v is the drop volume, r is the radius of the capillary tip, ρ_1 and ρ_2 are the densities of the respective phases and F, the correction function, depending on v/r^3, is derived from the drop-volume correction table.

Particle size analyses of nonaqueous emulsions were carried out by photomicrographic method[5]. Immediately after the preparation of an emulsion, the mean globule diameter (Dm) was determined. Further determinations were made at different temperatures in the range of 15°–60° C. Dm was calculated from the relationship[6]

$$Dm = \left\{\frac{n_1 D_1^3 + n_2 D_2^3 + \ldots + n_n D_n^3}{n_1 + n_2 + \ldots + n_n}\right\}^{1/3} = \left\{\frac{\Sigma n D^3}{\Sigma n}\right\}^{1/3} \qquad (2)$$

where n_1, n_2, ... n_n are the number of globules with diameters D_1, D_2, ... D_n, respectively.