$$\sin \eta_l = -\sqrt{\frac{\pi}{2}} \frac{2M}{K} \int d\tau_s \, \varphi_l(\mathbf{r}_s) \, \chi_0(\mathbf{r}_s) \int dR \sqrt{\frac{\pi}{2} KR} \, J_{l+1/2}(KR) \, V(\mathbf{R},\mathbf{r}_s) \, . \, F_l(R,r_l\{r_s\}), \quad (3)$$

where $\mathbf{r}_s$ stands for the set $\mathbf{r}_1, \ldots, \mathbf{r}_N$ and $d\tau_s$ for the product $d\tau_1, \ldots, d\tau_N$. This formula gives either the Born approximation when the potential $V(\mathbf{R},\mathbf{r}_s)$ tends to zero, and therefore $F_l(R,r_l) \to \sqrt{RK}\, J_{l+1/2}(KR)$, or the partial cross-section formula when we assume a rigid potential putting $V(\mathbf{R},\mathbf{r}_s)$ and thus also $F_l(R,r_l)$ independent of r_s. (For $l \neq 0$ when the velocity V of the $(\mathbf{R})$ particle tends to infinity, (3) gives Born approximations for phase shift.)

The application of the above method to the cases of elastic scattering of negative mesons by atoms and of neutrons by deuterons is in preparation and will be published elsewhere.

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R. Kołodziejski

Physics Department,
Victoria University,
Manchester 13.
July 16.

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Utilization of Aspartic Acid and Asparagine by Yeast

Much work has been carried out upon the mechanisms whereby yeast is able to utilize nitrogen from amino-acids for its nutrition, and the mechanisms worked out by Ehrlich and Stickland illustrating nitrogen uptake are well known[1,2]. These and other authors (for example, Thorne[3]) have been concerned with the value of amino-acids to yeasts simply as sources of nitrogen. Working with aspartic acid and asparagine, however, we have for some time observed that yeast growth has been stimulated under some conditions to a remarkable extent if either aspartic acid or asparagine has been present in nutrient solutions containing sugars and inorganic salts and nutrilites under various conditions of wort aeration. Under several conditions of experimental procedure, always with good aeration, it has been found that aspartic acid and asparagine added in relatively large amounts have always had the effect of increasing the yield of yeast obtained from a standard amount of fermentable sugar. Thus, under one set of conditions, it has been found that the addition of 1 gm. of asparagine would yield an additional 2·7 gm. of yeast (at 27 per cent dry matter) or 0·729 gm. of yeast dry matter. Also, while we have never been able to obtain yields of yeast (at 27 per cent dry matter) greater than 210 per cent of the hexose sugar supplied, this figure has, under some conditions, been greatly exceeded when either aspartic acid or asparagine has been present in the wort in sufficient amount.

These facts we attribute to the assimilation of the amino-acids as such by the growing yeast, the carbon skeleton of those substances being taken into the yeast. The mechanisms of Ehrlich and Stickland both neglect the possibility of assimilation of amino-acid *carbon* by yeast. If all the carbon of asparagine were assimilable by yeast, 1 gm. of asparagine (0·363 gm. carbon) would give 0·77 gm. of yeast dry matter (carbon average, 47 per cent). This assimilation can take place only when the yeast is at the same time supplied with fermentable sugars (probably as a source of the energy necessary to enable the assimilative mechanisms to proceed). Assimilation of the two amino-acids and subsequent yeast growth can, however, take place in the absence of biotin.

Recent work[4,5] has suggested that bacterial cell substance may be synthesized from sugars and ammonia in the following manner. Pyruvic acid (from normal fermentative breakdown of hexose) combines with carbon dioxide to form oxalacetic acid. This then combines with ammonia to form aspartic acid, which is presumed to form the basis for protein structure of the bacterial cell. Biotin is stated to catalyse part of this chain of reactions.

It appears to us that our observations may quite easily be explained upon such a basis as the above. If the normal yeast assimilative mechanism (by which hexose-sugar carbon and ammonia nitrogen are combined to form cell protein) passes through the stages noted above, it could be presumed that aspartic acid (or its amide asparagine) could be true intermediates in cell synthesis. In such a case, biotin would not be needed if aspartic acid (or amide) were supplied to the yeast, and such certainly does appear to be the case. The fermentable sugar is necessary to provide energy and probably other carbon groups for later cell anabolism.

J. White
D. J. Munns

34 Spring Road,
Birmingham 15.
July 21.

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The Precipitin Reaction and Antibody Valence Studied with the Aid of Radioactive Isotopes

Heidelberger and his colleagues[1] have made extensive quantitative studies of serological reactions using micro-methods for the determination of total nitrogen in specific precipitates, supplemented by the determination of the amount of dye present when dye-azoproteins were used as antigens. Other investigators have used antigens containing iodine[2], copper[3] and iron[4] to enable the amount of antigen to be determined in precipitates obtained from a wide range of mixtures of antigen and antibody.

For various immunochemical investigations during the past few years[5,6,7] we have been using antigens and antibodies labelled with radioactive isotopes. As antigens we have used lipovitellin containing phosphorus-32, proteins treated with mustard gas sulphone containing sulphur-35, and iodinated proteins containing iodine-131. We have also used antibodies labelled with iodine-131 or sulphur-35, for we have found that the introduction of small amounts of iodine or mustard gas sulphone groupings into antibodies, such as those to egg albumin, serum globulin