Editorial

Some Thoughts Regarding the P:S Ratio Concept*

THIS editorial is written in the hope that it may discourage the inclusion in the language of a term which is potentially highly misleading.

Dating from the original observation from this laboratory that the substitution of certain vegetable fats for equal amounts of animal fats resulted in a maintained fall in plasma lipids, much work has been carried out to determine the mechanism of this effect. During the period 1952 to 1956 we demonstrated that (1) the addition of cholesterol to vegetable fat-containing formulas in amounts far in excess of those present in any mixed diet would not increase plasma cholesterol to any but a minor degree, (2) the administration of large amounts of vegetable phospholipids had a hypocholesterolemic effect only when the phospholipids contained fairly large amounts of polyunsaturated fatty acids, (3) vegetable sterols lower plasma lipids only when administered in amounts far in excess of those found in natural vegetable fats, (4) vegetable oils containing little or no polyunsaturated fatty acids and no cholesterol actually increase plasma lipids, and (5) purified ethyl linoleate produces as great a decrease, or greater, in plasma lipids as vegetable fat containing this fatty acid.

During this same period, and more recently, a number of other investigators have published findings which are in substantial agreement with most of the observations noted.

From the foregoing, it seemed reasonable to conclude that the *hypolipidemic* factor in vegetable fats was chiefly the polyunsaturated fatty acids which they contained and, conversely, the *hyperlipidemic* agents present in other fats were chiefly the saturated fatty acids present in them. The precise role of the monounsaturated fatty acids remained in less than sharp focus.

In 1957 Keys proposed a formula for determining the hyper- or hypolipidemic properties of a given fat or fat mixture. This formula was based on the hypothesis that a critical relationship existed between the *relative* amounts of polyunsaturated and saturated fatty acids. Monounsaturated fatty acids (regardless of amount) were assumed to be "neutral" or nearly so.

Joliffe's group, in the organization of a long-term study designed to determine the effects of a "prudent diet" on plasma lipids, made use of the term "P:S ratio" as a teaching and descriptive device. The philosophy behind this term was essentially the same as that underlying Keys' hypothesis.

In examining this concept, it becomes apparent that, if it were correct, a diet containing 3 gm. of fat made up of 2 gm. of linoleate and 1 gm. of palmitate should produce effects upon plasma lipids identical to one containing 100 gm. of fat with polyunsaturated fatty acids equal to 2 gm. and saturated fatty acids to 1 gm.; or polyunsaturated fatty acids 60 gm. and saturated fatty acids 30 gm.

There is much published and unpublished evidence to indicate that such a concept is quite untenable. As a case in point, a study was carried out recently under the quantitatively constant conditions of the metabolic ward, in a subject known to be quite responsive to dietary modification, in which the effects of five oils, four of them high in polyunsaturated fatty acids and one high in monounsaturated

* The work included in this editorial represents the joint efforts of several members of the Institute, particulary of Dr. Barbara Gunning.

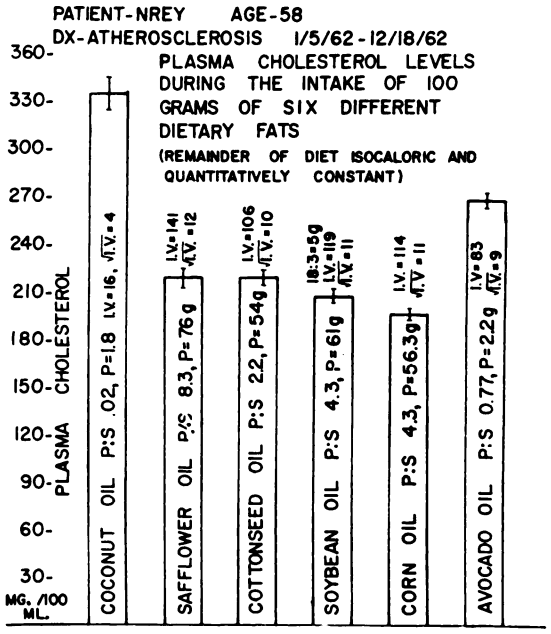

FIG. 1. All oils were fed for minimal periods of four weeks. Plasma lipids were measured thrice weekly. The values shown represent the mean values for the last two weeks on each oil. The slightly lower cholesterol values on soy bean and corn oil are probably attributable to the fact that they were the last two "polyunsaturated oils" fed, rather than to an actual greater efficacy as compared to the first two oils; i.e., after the initial rapid fall of cholesterol, a very slow decrease occurred over a period of several months.

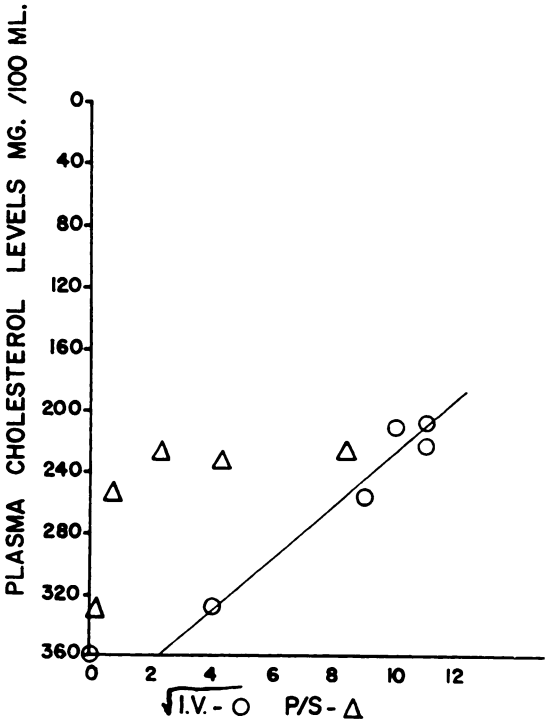

FIG. 2. There is some suggestion of inverse correlation between the square root of the iodine value and the cholesterol level, *at this level of fat intake*. Other studies indicate that additional factor(s) must be introduced at lower and possibly higher levels of fat intake. Lack of correlation of P:S with plasma cholesterol is obvious.

fatty acids, were compared with an almost completely saturated oil (coconut oil). The mean cholesterol values, as well as the P:S ratios, iodine numbers, actual amount of polyunsaturated fatty acids and square roots of the iodine numbers are shown in Figure 1. It is quite obvious that, under the conditions of the study (fat ingestion 100 gm. daily, equal to 45 per cent of calories), the degree of cholesterol depression produced by all four of the polyunsaturated vegetable oils was essentially equal. The minimal amount of polyunsaturated fatty acid consumed daily was slightly more than 50 gm.; the maximum approximately 75 gm. The P:S ratios vary to a great degree in these four oils. Hence, if the hypocholesterolemic effects were a function of this ratio *per se*, major differences in the cholesterol levels would be expected. Such is not the case. Further, the effect of the oil high in monounsaturated fatty acids was much greater than would be possible on the basis of the P:S ratio concept.

It seems probable that some mathematical expression may be derived which will permit the prediction of at least the approximate effect of a given amount and kind of fat upon the plasma lipid levels. Such an expression will bear a significant relationship to absolute quantity of polyunsaturated fatty acids and to other factors as well. On the basis of some available data it seems possible that such an expression may be related to the square root of the iodine number *and* the total amount of the fat (Fig. 2).

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