VITAMIN A ISOMERS IN ANIMAL LIVERS

by

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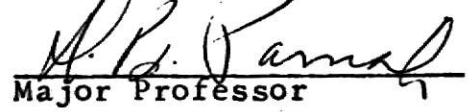

Major Professor

TABLE OF CONTENTS

I. INTRODUCTION

For some 60 years vitamin A has been recognized as one of the required factors in animal diets. Vitamin A is an important growth factor. In its absence deficiency symptoms appear especially in epithelial tissues. Xerophthalmia, which may lead to blindness, formerly was a common condition among poor people, and night blindness often was found among adults. Today, with a better understanding of nutrition and the use of supplements in diets, the situation has improved.

The total vitamin A content of a food or feed by the customary methods of assay may not yield useful analytical data, since it is the physiological activity of the vitamin--the availability to the animal organism--that is of real concern. When the International or USP unit is used to express vitamin A content, it means the "activity" of 0.344 mg of crystalline all-*trans* retinyl acetate (0.3 mg of retinol). Biopotency of vitamin A is related to activity and not to weight. Biopotency of vitamin A expresses true nutritional value; it is based on an activity value of 100% for all-*trans* vitamin A, the predominant form in both natural and synthetic products.

Due to the conjugated double bond system in the vitamin A molecule, isomerism of the *cis-trans* type is possible and any modification in the characteristic conjugated double bond system of the all-*trans* retinol results in a loss of biological activity of the vitamin. Theoretically, 32 isomers of vitamin A are possible. The all-*trans* and three *cis-trans* forms (13-mono-*cis*,

9-mono-cis and the 9,13-di-cis, with lower biopotencies) are those most commonly found in commercial preparations and are of greatest concern (Plate I).

The cis-isomers, together with other vitamin A forms, such as vitamin A_2, anhydrovitamin A_1 and A_2, oxidation products of vitamin A, carotenoids, kitol, unidentified molecules, and small amounts of intermediates contribute to "irrelevant absorptions," giving incorrect and high values for retinol when the customary assay methods are used.

The purpose of this investigation was to determine the relative proportions of the commonly found vitamin A isomers in some animal livers and the resulting biopotencies of the liver vitamin A. In addition, studies were made on effect of light, temperature, and length of storage time on those values. Hexane extracts of livers were treated with iodine and exposed to light to observe isomeric changes that might occur under such conditions.

II. REVIEW OF LITERATURE

A. Cis-Isomers

Isomerization. In 1939, Smith (1) reported that it seemed likely that the vitamin A in an oil or concentrate existed as a mixture of geometrical isomerides, and that on irradiation, energy is absorbed causing a change in the proportion of isomerides.

EXPLANATION OF PLATE I

The all-*trans* and most common *cis*-isomers of retinol.

Fig. 1. All-*trans* retinol.

Fig. 2. 13-mono-*cis* retinol.

Fig. 3. 9-mono-*cis* retinol.

Fig. 4. 9,13-di-*cis* retinol.

PLATE I

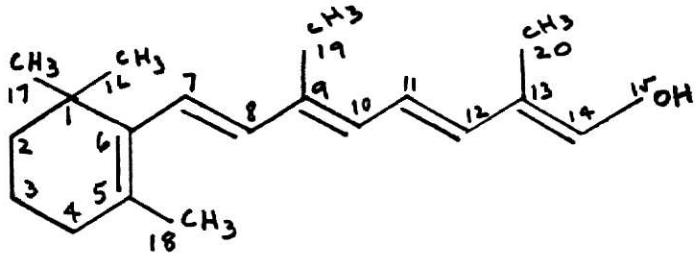

Fig. 1.

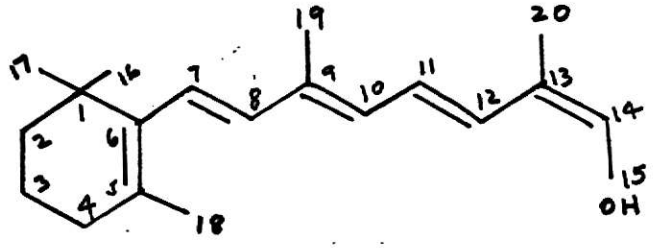

Fig. 2.

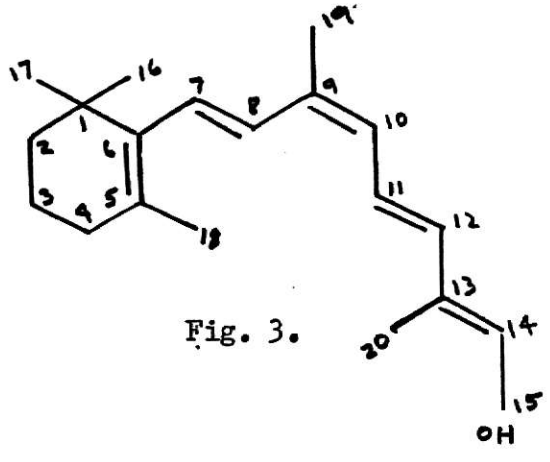

Fig. 3.

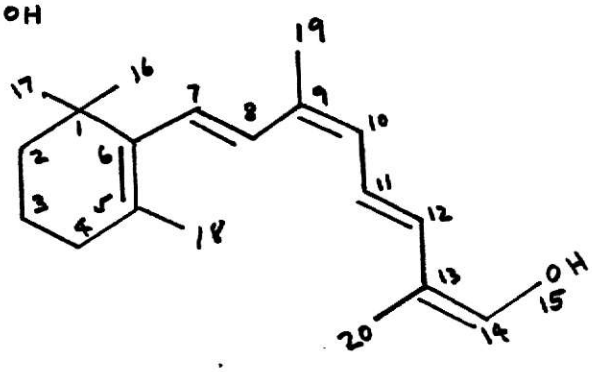

Fig. 4.