COLLAGEN FIBRES FROM FISH GUT

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The guts of most fishes contain 1-5% collagen. Amino acid composition of these purified collagens revealed the presence of almost all amino acids except cystine. The major component amino acids were glutamic acid followed by proline and glycine. The physical properties such as tenacity, keeping quality etc. of pure and modified collagen fibres are also reported. In the light of these data, the use of gut collagen as a surgical suture is discussed.

Introduction

Collagen is the major component of skin, tendon, bones and teeth. It is also present in appreciable amounts in the intestines of animals and fish. The average collagen content of fish is only 1-5% (Jacquot, 1961) compared to 5-30% in terrestial animals (Walls, 1960; Veis, 1978). However the collagen contents of the guts of fish and animals are very much similar. The intestines of most fish are of comparatively smaller dimensions than other animals. They have sufficiently long collagen filaments. These properties of fish gut collagen make them suitable for preparing extra fine absorbable surgical suture.

The use of a collagen thread as a surgical suture depends on its tenacity, durability, pliability, absorbability and certain chemical properties. So far, there is no reported work on the collagens of fish intestines particularly with a view to use them as surgical suture. The paper describes some of the above properties of pure as well as modified fish gut collagens.

Materials and Methods

Collagens of the fish intestines were prepared by first squeezing out the contents followed by washing with water and dilute salt solutions. The washed intestines were suspended for a few hours in a pickling solution containing sulphuric acid, sodium chloride and chromium salts prepared according to Turley (1958) to remove all soluble proteins and to give pure collagen fibres.

The collagen fibres so obtained were then strengthened by crosslinking with diacetyl according to Turley (1958). The crosslinked collagen fibres were then dried in air and a portion of them were coated with a 1% solutin of chitosan and air dried at ambient temperature followed by nutralisation with dilute ammonia (C-coated threads).

The other portion of the crosslinked collagen fibres were given a coating of gelatin containing 1% succinic anhydride. It was dried in air at ambient temperature washed to neutral pH and dried again (G-coated threads). The threads were packed in air tight polythene bags in a medium containing 92% iso-propyl alcohol.

The tenacity of the collagen threads were determined using a tensile strength testing machine. The threads were tested for tenacity before and after storing for 6 months to study the durability of the threads. The pliability of the threads was determined by feeling the stiffness of the fibres in between finger tips.

The amino acid composition of the pure and treated collagen fibres were determined by hydrolysis with 6 N HCl followed by analysis in NC 2P Amino Acid Analyser, Technicon, USA according to Hirs (1972).

Results and Discussion

Collagen and its derivatives like gelatin are widely used in leather and film industry. They are also used for making medical aids like sutures, cargil membrances, surgical sponges and collagen flours. Even today, preparation of opthalmic grade sutures are very difficult due to non-availability of fine collagen filaments in nature. The collagens of most fish intestines offers 1-5% of collagen fibres, which are very much suitable for making opthalmic grade sutures.

A collagen fibre to be of surgical value must have certain physical characteristics like, durability, pliability, sufficient knotpull strength and absorbability without any reaction. The results of a study of some of these properties are shown in Table 1. The table indicates pliability, knotpull strength as tenacity in g/denier and durability as loss in tenacity during a period of 6 months storage at room temperature. Of these 3 different types of fibres studied tenacity was maximum for the G-coated fibres. It was also pliable and durable and is similar to the commercial sample. This was followed by the C-coated fibres. However eventhough C-coated fibres are durable its pliability is very poor. The pure collagen fibre was pliable but its tenacity and durability were poor. From

physical properties it is evident that G-coated fibres are very much suitable as suture material. Eventhough the C-coated fibres are sufficiently strong its rigid surface probably due to the hydrophobic nature of chitosan make it unsuitable as a suture thread.

The degree of crosslinking and strong chemical bonding in protein fibre will be clear from the amino acid composition of the treated and untreated fibres (Mellon, 1958). Table 2 shows the amino acid composition of pure, C-coated and G-coated fibres. In pure collagen the predominant amino acids were glutamic acid followed by proline, and glycine. A comparison of the amino acid compositin of the 3 types of fibres shows a significant reduction in the percentage composition of aspartic acid, glutamic acid. proline and arginine. These changes can be explained assuming the possibility of some of these amino acid melocules entering into some sort of chemical reaction resulting in a compound which is either resistant to acid hydrolysis (Mellon, 1958) or on acid hydrolysis produces a modified compound different from the parent amino acid. Further some of these amino acids may be suitably placed in the protein molecule to facilitate such chemical reactions. Consequently the treated fibres upon hydrolysis give an amino acid composition with higher percentage for the amino acids which are not involved in such reactions.

From the above results it is clear that extra fine collagen threads can be prepared from the collagen fibres of fish gut. The threads prepared by crosslinking and gelatin coating have physical properties comparable to commercial surgical sutures

of same grade. The biological properties of the suture such as tissue reaction, the period for absorption in the body etc. are under study and will be published in a subsequent paper.

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Table 1

Some physical properties of the collagen fibres from fish gut

Type of collagen fibre 6-0 grade	*Pliability*	*Tenacity*	Durability % (loss of tenacity after 6 months)
Pure collagen	Pliable	0.79	30
C-coated	Rigid	2.30	0
G-coated	Pliable	2.41	0
Commercial sample	Pliable	2.50	0

Table 2

Amino acid composition of pure and modified collagen fibres g/100 g

Amino acid	Pure	C-coated	G-coated
Aspartic acid	11.3	10.20	8.76
Threonine	3.5	5.10	3.65
Serine	5.9	4.28	4.03
Glutamic acid	18.1	15.84	14.44
Proline	13.1	8.29	11.13
Glycine	12.2	11.05	18.30
Alanine	7.2	7.04	9.05
Valine	2.5	4.34	4.45
Methionine	2.3	2.86	--
Cystine	0.03	--	--
Isoleucine	1.8	3.83	3.31
Leucine	3.9	6.89	5.51
Tyrosine	0.89	1.42	4.90
Phenylalamine	2.4	2.96	1.17
Histidine	1.2	2.69	2.29
Lysine	5.6	6.36	5.90
Arginine	9.4	5.03	2.63