BIOLOGY

Phases of the Hair-Growth Cycle

Morphological considerations led Dry[1] to distinguish three stages in the hair-growth cycle; namely, anagen, catagen and telogen. Anagen referred to the period of active growth, including development of the follicle and subsequent synthesis of the hair. The rapid growth in anagen abruptly ceases and the follicle is largely destroyed in a brief phase, termed by Dry as catagen. The follicle remnant and associated hair are in a phase of apparent inactivity known as telogen in Dry's system. This classification of the hair-growth cycle has been extended[2] by subdividing anagen into six phases on the bases of detailed histological observations.

These 'structural' classifications include in one phase (anagen) developmental and functional stages of the hair follicle, and yet distinguish degeneration of the follicle as a discrete phase (catagen). From a physiological point of view, this is clearly unreasonable. To classify the hair-growth cycle in a histologically and physiologically acceptable manner, it is suggested that the term anagen refer only to the phase of follicle development and that the functional phase, between anagen and catagen, be known as metagen. Specifically, metagen would commence with the keratinization of the hair shaft and continue until the synthesis of the hair ceases at catagen.

On structural grounds, telogen has frequently been described as dormant[1-8]. If this were so, it would be permissible to consider the hair-growth cycle as consisting of periods of activity followed by periods of inactivity. Such an interpretation of the growth cycle is, however, misleading, since telogen is not a phase of 'rest'. Metabolically telogen may be regarded as a phase of recovery from the destructive metamorphosis of the hair follicle in catagen. It is the metabolic activity in telogen, however subdued, that results in the initiation of the histological events associated with the phase of anagen. Indeed, the propensity of the follicle to grow hair is a reflexion of metabolic activity during telogen.

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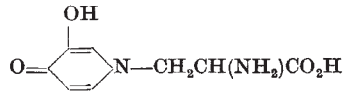
Inhibition of Growth of Hair by Mimosine

Loss of hair in animals following ingestion of seeds and foliage of *Leucaena glauca* was first reported in 1897 [1]. Sudden loss of hair in native women has been ascribed to consumption of *Leucaena glauca* seeds[2]. The toxic principle contained in this plant is a water-soluble amino-acid termed leucenol, and is identical with mimosine obtained from *Mimosa pudica*[3]. Mimosine seems to be the preferred name for the compound, both by historical precedent[4] and to avoid confusion with leucinol, an alcoholic derivative of leucine. Mimosine is found primarily in the seeds of *Leucaena glauca*, lesser amounts being present in the foliage and stems[5]. Its chemical structure is:



In this investigation, both purified mimosine and ground seeds of *Leucaena glauca* caused inhibition of growth of hair and loss of hair in mice. Mimosine was extracted from whole ground seeds with boiling water[6]. Its absorption spectrum measured in a Beckman *DU* spectrophotometer was identical with that of a sample obtained from a commercial source (Fluka AG, Chemische Fabrik, Buchs SG). Purity was confirmed by unidimensional paper chromatography (methanol/water/pyridine, 80 : 20 : 4) and column chromatography (150 × 0·9 cm. sulphonated styrene—8 per cent divinyl benzene, Spinco 150*A*, 50° C. at *p*H 4·25).

Mimosine or whole ground seed was mixed with ground commercial mouse pellets and formed into cakes by the addition of agar. Groups of mice were fed with cakes containing 5 per cent and 10 per cent whole ground seed and 0·5 per cent and 1·0 per cent mimosine. Control animals received cakes prepared without seed or mimosine. A large area of the body of each animal was plucked free of hair to induce a new anagen cycle in the hair follicles of these areas.

All animals eating the control diet re-grew thick hair coats in the epilated areas within 8–10 days. The animals fed 5 per cent ground seed and 0·5 per cent mimosine also re-grew hair normally. No hair re-growth was observed in animals receiving 10 per cent ground seed or 1·0 per cent mimosine (Table 1). The 1·0 per cent mimosine diet was continued for 9 weeks with no evidence of new hair in the plucked areas. During the ninth week, loss of hair on the face and head of these mice was noted.

Damage to the roots of hairs in human beings is caused by a variety of cytotoxic therapeutic agents[7]. This damage is due to an inhibition of growing (anagen) hairs. Resting (telogen) hairs are not affected. Gross evidence of loss of hair depends on the degree of damage to the growing hair root. If complete atrophy occurs, the hair is shed from its follicle. Damage to growing hair roots reflects the high metabolic and mitotic activities of these tissues. Compounds toxic for rapidly growing tissues usually cause a proportional degree of damage to hair[7].

The loss of resting hairs is a gradual, continuous physiological process. Normally these hairs are replaced by new growing hairs. If growth of new hair is inhibited there can be no replacement. As a result, the amount of hair remaining is slowly reduced and is often overlooked until it becomes severe. It is this type of loss of hair which occurred on the face and head of mice fed for a long period on 1·0 per cent mimosine.

Table 1. Effects on Growth of Hair by feeding *Leucaena glauca* Seeds or Mimosine in Mice

Diet	Hair regrowth in plucked area at 8–10 days	Hair loss in facial area at 8–9 weeks
Control	+	0
5 per cent seed	+	0
10 per cent seed	0	+
0·5 per cent mimosine	+	0
1·0 per cent mimosine	0	+