said conditions is 600 μg mixture containing 200 μg of each of K^+, Rb^+ and Cs^+.

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ON FISHER'S FUNDAMENTAL THEOREM OF NATURAL SELECTION WITH NON-OVERLAPPING GENERATIONS

THE Fundamental Theorem of Natural Selection first given by Fisher[1] broadly appears in two forms (Turner[2]). According to one form, the change in the average fitness of a population is equal to the genotypic variance in fitness. The other form, which includes the effect of a mating system, states that for random mating population, with two-allele system, the rate of increase in average fitness at any time is equal to its additive genetic variance at that time. Thus in the absence of dominance these two forms are identical. However, the interpretation of the dominance in a two-allele system is essentially that of an interaction between the two alleles, the three fitness values attached to the three genotypes forming an arithmetic series in the absence of dominance. Now it may happen that the three fitness values may form a geometric series so that on the logarithmic scale there would be no dominance although on the arithmetic scale some partial dominance will be exhibited resulting in two different forms of the theorem. The purpose of this communication is therefore to show that in situations where the dominance is due to scale effects, the two forms of the theorem would still be identical, although the variance due to dominance deviations on the arithmetic scale is not zero.

Let the relative fitness of the three genotypes *AA, Aa* and *aa* be respectively w_2, w_1 and w_0 in a random mating population with gene frequencies p for A and q for a with $p + q = 1$. The average fitness of such a population, denoted by $\bar{w}$ can be expressed as

$$\bar{w} = pw_2 + qw_0 - pq(w_2 - 2w_1 + w_0) \quad (1)$$

where $(w_2 - 2w_1 + w_0)$ expresses the degree of dominance on the arithmetic scale. After the operation of natural selection the increase in average fitness denoted by $\Delta \bar{w}$ is

$$\Delta \bar{w} = \sigma_{\bar{w}}^2 / \bar{w} \quad (2)$$

where σ_w^2 is genotypic variance of the fitness values. Now the genotypic variance is the sum of additive and dominance variances which can be expressed respectively as

$$\sigma_A^2 = 2pq[\bar{w}(w_2 - 2w_1 + w_0) + (w_1^2 - w_2 w_0)] \quad (3)$$

$$\sigma_D^2 = p^2q^2(w_2 - 2w_1 + w_0)^2. \quad (4)$$

An alternative expression for the change in the average fitness can then be shown to be equal to

$$\Delta \bar{w} = \frac{\sigma_A^2}{\bar{w}}\left[1 + \frac{pq(w_2 - 2w_1 + w_0)}{2(\bar{w} + \theta)}\right] \quad (5)$$

where

$$\theta = (w_1^2 - w_2 w_0)/(w_2 - 2w_1 + w_0). \quad (6)$$

Taking into account the round of random mating in addition to the effect of natural selection, the change in the average fitness of the population, denoted by $\Delta \bar{w}^*$ is, according to the derivations of Li[3] and using (1), given by

$$\Delta \bar{w}^* = \frac{\sigma_A^2}{2\bar{w}}\left[1 + \left(\frac{pw_2 + qw_0}{\bar{w}}\right)\right]$$

$$= \frac{\sigma_A^2}{\bar{w}}\left[1 + \frac{pq(w_2 - 2w_1 + w_0)}{2w}\right]. \quad (7)$$

Comparing the two expressions (5) and (7), it is clear that even if $(w_2 - 2w_1 + w_0)$ is not zero, the two $\Delta \bar{w}$ and $\Delta \bar{w}^*$ are identical provided $w_1^2 = w_2 w_0$. This would mean that, on the geometric scale, there is no dominance.

It is apparent therefore that while the behaviour of the average fitness under natural selection without involving the effects of mating system is more rigorous, the change in average fitness, taking into account the random mating, is very much dependent on the scale on which the fitness values are measured This also points out to the limitation of the concept of the additive genetic variance in that it involves the linearity assumption. On the other hand, the genotypic variance is a quantity free from any such assumption and therefore the Fundamental Theorem of Natural Selection employing it, *viz.*, in the form of (2) is much more general than its other form given by (7) which has been debated by several workers.

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HISTOLYSIS OF PEDIPALPAL MUSCLE OF THE SCORPION *HETEROMETRUS FULVIPES* (C. KOCH) DURING MOLTING

LITERATURE on arachnid metabolism during molting is scarce. On the other hand ecdysial metabolism in insects and crustacea is extensively worked out. The present communication makes a preliminary report of hitolysis in the pedipalpal chelate muscle of the scorpion, *Heterometrus fulvipes*.

A similar correlation between increased water content and granulation of muscle has been noted when the muscle atrophies due to deprivation of its innervation in the scorpion[2] and in the vertebrates[3-7]. It may, however, be noted that this comparison between liquidization of muscle during molting and that occurring due to denervation has to be confined only to the limited extent of physical appearance and increase in water content since the causo-mechanisms for these two processes are different: denervation atrophy involves an important deprivation of trophic influence of the nerve on the muscle whereas in liquidization associated with molting no such clear-cut trophic influences can be implicated.

The muscle total weight (holo-histontic weight) obtained by pooling the muscle masses of chelae of both pedipalpi of the scorpion, as also the histosomatic index (HSI, obtained by calculating the weight of chelate muscle per cent total body weight) show important decreases in the molted scorpion, although the decrease in the HSI is not statistically significant (Table I). The decrease of the above

TABLE I

Pedipalpal chela muscle, weight, its histosomatic index and some biochemical parameters in relation to molting in the scorpion Heterometrus fulvipes

Parameter	Normal	Post-molt		d.f.	P	% Change
Muscle weight (mg/g wet)	[a]522 ±49·17 (4)	269 (1)	[b]4·602	3	<0·02	− 48·5
Histosomatic index of muscle (HSI)	82·18 ±3·416 (4)	3·461 (1)	1·245	3	NS	−57·9
Total protein (mg/g wet)	87·757±6·876 (4)	138·28 (1)	6·573	3	<0·01	+57·6
TFFPS (μg/g wet)	12·06 ±2·992 (4)	38·69 (1)	7·961	3	<0·005	+220·8
Total protein (Holohistontic levels, HHL) (mg/tissue)	45·60 ±2·771 (4)	37·20 (1)	2·711	3	NS	−18·4
TFFPS (HHL) (μg/tissue)	6·328±1·733 (4)	10·41 (1)	3·656	3	<0·05	+64·6

a. Values are means ± standard deviations (numbers of estimation).
b. Statistical treatment (according to Pillai and Sinha[11]).
t = Calculated students' t test values.
d.f. = Number of degrees of freedom.
P = Level of significance of difference. NS = Not significant.

In our collection of the scorpions, we came across a female specimen, clearly in the post-molt condition. The animal was lethargic and the skin was soft and transparent. No attempt was made to stage the animal in the molt cycle as proposed by Drach[1]. The flexor-extensor muscle mass was exposed in the chela of the pedipalp by incision of the exoskeleton. It was granulated and had a more fluid appearance than that of the normal scorpion. This 'liquidized' appearance may be due to increased water content.

parameters are indications of high level of atrophy undergone by the muscle during molting. The total proteins, estimated with Folin-Ciocalteu reagent[8] in the residues of trichloroacetic acid (TCA) homogenates were significantly greater in the 'molted' muscle as compared to the normal muscle. However, the total protein content when expressed in terms of the whole tissue (holo histontic level = total individual tissue level), showed decrease (− 18·4%). The total free Folin-positive substances