Octacosanol ingestion and its effects on Metabolic Responses to submaximal cycle ergometry, reaction time and chest and grip strength.

by

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ABSTRACT

Sixteen physical education students and lecturers (eight experimental and eight placebo) were pre-tested for chest and grip strength, predicted maxVO$_2$ using an incremental bicycle ergometer test and reaction time in response to both visual and auditory stimuli. The experiment was conducted in a double blind format. The experimental group ingested one capsule containing 1000mcg of octacosanol per day for eight weeks while the placebo group ingested a similar sugarless gelatin capsule. The groups were then post tested after eight weeks and the results were compared using Analysis of Variance (ANOVA).

No significant changes were found in chest strength, auditory reaction time, or endurance as measured by the cycle ergometer test. Grip strength and reaction time to a visual stimuli improved consistently and significantly at, or greater than the minimum level of significance. A small (but not statistically significant) improvement was seen in auditory reaction time. The results suggest that octacosanol can be used as an ergogenic aid to improve some parameters of strength and reaction time.

Key Words: Octacosanol, reaction time, strength, ergogenic aid.

INTRODUCTION

Ergogenic aids (anything which improves or is thought to improve performance) have long been a subject of contention both morally and physiologically. The International Olympic Committee (IOC), and other athletic bodies have banned the use of drugs and other substances thought to improve performance, and any athlete known or found to be

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using them is banned from competition. Some of the substances claimed to have ergogenic properties in the past have been caffeine (Costill, 1978; Costill et al., 1978; Ivy et al., 1979), vitamin E (Cureton, 1954), pargamic acid (B15 — Girandola et al., 1980), oxygen (Bannister, 1954; Hagerman, 1968; Allen, 1977) and amphetamines (Karpovich, 1959; Golding, 1963).

It is interesting to note that for each claim of ergogenic properties for a particular substance there is an equal number of experiments disclaiming the substance. Fox and Matthews (1981) suggests that there exists a general lack of objective and consistent information regarding the effects of drugs and ergogenic aids on performance.

Octacosanol is a substance which is presently being 'touted' as an ergogenic aid in many of the gyms and health clubs around the country and is being marketed as a sports supplement. Octacosanol is a natural food substance which is present in very small amounts in many vegetable oils and waxes, in the leaves of alfalfa and wheat, in wheat germ as well as in a variety of other foods. It is also found in animal sources and is a component of some petrochemical substances including paraffin (Fieldman, 1982). In 1937, the properties of octacosanol were described by Francis, Collins and Piper in a paper which expounded constants for various long chain n-fatty acids and their derivatives; ethylesters, alcohols and iodides, (C28-C38). Octacosanol however, was not isolated in any quantity until sometime in the 1950's when Thomas Cureton began studies of the product on a large scale.

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Table 1. Mean Characteristics for Octacosanol Subjects.

Early investigators had discovered that wheat germ oil (WGO) produced significant effects, particularly in regard to reproduction. Currie (1937) found that it significantly reduced habitual abortion in humans, whereas Dukelow (1968), found that it was effective in reducing artificially induced embryonic mortality in rabbits. Certain neurological disorders in dogs and humans have been shown to be improved by the use of WGO (Milhorat, 1945; Milhorat et al., 1945; Rabinovitch, 1951). Other authors (Ershoff and Levin,
1955\textsuperscript{19}; Alfin-Slater et al., 1960\textsuperscript{20}) have suggested unidentified active factor(s) present in WGO responsible for improved performance and reduction in the liver cholesterol stores.

It was known that WGO was relatively rich in vitamin E, and it was generally accepted that vitamin E was the active ingredient. It was not until 1939, when pure forms of vitamin E became available for research that this was disproved and the way was opened to isolate the unknown factor. Levin (1945\textsuperscript{21}), makes the sharp distinction between vitamin E and WGO, disclaiming vitamin E as the active ingredient and suggesting biologically active substances other than vitamin E.

The first pioneering experiments in the area of octacosanol were performed by Cureton. Cureton's studies were concerned with the effect of WGO on strength, stamina and reaction time (RT), and cardiovascular function in human beings. His experiments led him to the conclusion that octacosanol was the "unknown factor" in WGO rather than vitamin E as previously thought. His work incorporated nearly 900 human subjects in 42 physical training programs. The subjects were of all ages and all degrees of fitness. Close attention was paid to detail, with objectivity and validity being of high priority. Careful matching and screening procedures and double blind tests were always used to ensure that the results were as accurate as possible.

<table>
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<tr>
<th>Subject</th>
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<td>M</td>
<td>30</td>
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| X       |      | 22.25 | 171.5 | 67.7* |
| Sd      |      | 5.8   | 8.9   | 10.2  |

Table 2. Mean Characteristics for Placebo Subjects.

Cureton's results showed that WGO furnished a type of nutrition, more effective (due to octacosanol), than previously considered a possibility (Cureton, 1972\textsuperscript{22}). The results show statistically significant effects, at the 0.05 levels of significance, on several types of endurance performance, total body RT, basal metabolism, oxygen uptake tests and oxygen debt. Octacosanol was found to be the active energy releasing factor, since improvement in performance was related to octacosanol fed and not other variables.
The effects of octacosanol were shown to manifest themselves after a period of 4 to 6 weeks of ingestion. The differences found were large enough to affect, in a practical way, the relative order of finishing a race, for example the 1500 metres, or ratings in other physical tests, for example RT. The 1962 patent for octacosanol quotes,

"The physiological advantage was shown in terms of running endurance in all our treadmill runs, T-wave of the electrocardiogram, lower systolic blood pressure, the Schneider index and illinois total body reaction time tests, in response to light, sound and combined signals." (Fieldman, page 9).

Fieldman goes on to say that octacosanol is now accepted as an ergogenic aid,

"It improves endurance, speeds reaction times, provides glycogen, strengthens muscles and reduces the oxygen debt." (Fieldman, page 10)

Wheat germ oil has often been quoted as an ergogenic aid which increases endurance. The biologically active factor has been shown to be octacosanol rather than vitamin E as originally thought. It is suggested that it acts by reducing the oxygen requirements of the tissues and improves coronary collateral circulation. Many studies by Cureton have shown an improvement in endurance activities due to octacosanol (but thought to be vitamin E in WGO), but these have generally speaking not been replicated by others. This experiment aimed to test the effect of ingestion of octacosanol on the metabolic response to submaximal exercise, strength and reaction time parameters (Cureton, 1972).

<table>
<thead>
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Table 3. Mean Reaction Times in Response to Visual Stimulus.

\[(\text{sec} \times 10^{-3})\]

Methods

Sixteen people from a college population, of varying degrees of fitness volunteered to participate in this study. Before undertaking the study they were all informed as to the aims and the possible risks involved and they all signed informed consent. The sixteen subjects, eight male and eight female were then randomly assigned (by sex) to the two groups, experimental and placebo.

Test Protocol.

The subjects were first tested for strength using the same grip and chest strength dynamometers. Grip and chest strength were chosen as being representative indices of body strength. The subjects were then tested for reaction time using a Dekan, model 741 timer with a pressure plate and light and sound stimuli. In response to a stimulus (either the light or sound) the subject was required to jump vertically off the pressure plate to break contact. The time between the production of the stimuli and the breaking of contact was recorded. This time delay represents reaction time and movement time — but for the purposes of this study it was termed reaction time (RT). The delay between the command 'ready' and the production of the stimulus was randomly varied between 0.5 and 3.0 seconds. The subjects did not have knowledge of results until after the test. The subjects...
also performed on incremental bicycle ergometer tests over nine minutes, with the heart rate being taken in the last fifteen seconds at the end of every three minute period. The experimenter was well practiced in taking heart rates by palpation. The max VO$_2$ was calculated on the basis of the results gained from this test.

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Table 4. Mean Reaction Times in Response to Auditory Stimulus.

Each subject was then given a bottle containing 56 capsules. One capsule was to be taken each day for an eight week period. Group A was given 'Bioglan' octacosanol and group B was given a sugarless gelatin capsule with physical characteristics identical to those of the octacosanol. A double blind experimental procedure was followed. Further, the subjects were asked not to engage in any uncharacteristic physical activity while the experiment was be conducted.

After the eight week period the subjects were post-tested using an identical format to that used for the pre-tests. As far as was possible the tests were conducted at the same time of day under identical conditions to those found in the pre-test situation. The results were tabulated and an analysis of variance (ANOVA) was used to compare the pre and post tests and the experimental and placebo groups. A minimum level of significance was established at the 0.05 level.

Results

The physical characteristics of the subjects for both the placebo and octacosanol groups are shown in Tables 1 and 2. There were no significant differences between the two groups on any of the experimental parameters measured pre-test, neither were there any statistically significant differences in the physical parameters.

The reaction times in response to the visual (light) stimulus were reduced consistently in the octacosanol group at the 0.01 level ($F_{1,14} = 10.56$) of significance. There were no differences in the control (placebo) group pre-test to post-test. In response to the auditory stimulus presented there were small but not statistically significant differences between the pre and post test octacosanol group. An analysis by subject found that there was a statistically significant effect at the 0.05 level of confidence for two of the eight octacosanol subjects. Once again none of these changes were seen in the placebo group for the auditory stimulus. The mean reaction times for both the visual and auditory stimuli are shown in Tables 3 and 4.

When grip strength was analysed it was found that there was a slight increase in the performance of the octacosanol subjects over the eight week ingestion period. When this was compared to the results of the placebo group there was a significant difference at the 0.025 level of significance ($F_{1,14} = 6.51$).
An analysis by sex showed some significant differences in improvement between males and females on some of the parameters measured after ingestion of the octacosanol. That is, males and females were seen to differ slightly in improvement or lack of it after ingestion of octacosanol. The males showed significant differences at the 0.025 level of significance on grip strength between pre and post test measures (\(F_{1,16} = 12.97\)) whereas the females did not show any differences between pre and post test. Both males and females showed significant differences at the 0.01 level of significance when the visual stimuli were compared pre and post test (\(F_{1,6} = 21.26\) [males]; \(F_{1,6} = 20.35\) [females]).

**Discussion**

The data of this experiment fail to support the hypothesis that ingestion of a regular small daily dose of octacosanol (1000mcg) over an eight week period significantly improves chest strength, max VO\(_2\) or reaction time in response to an auditory stimulus. The present data does however lend support to the hypothesis that the same dose of octacosanol significantly improves reaction time in response to a visual stimulus and grip strength as measured on a grip strength dynamometer.

These results can be compared to those of Cureton\(^2\) (1972). According to Dubick\(^2\) (1983), Cureton’s work received considerable credibility but has not generally been replicated by other studies in the same area. Furthermore, others have been unable to show that wheat germ oil or its derivatives (octacosanol) improve human physical performance.

Closer examination of Cureton’s (1972\(^2\)) results show that out of three experiments on strength, there was a statistically significant result once, a trend advantage once and no significant difference once. Out of thirteen experiments carried out on endurance, there were ten which produced statistically significant improvements. Our results do not show any improvement in endurance as measured by a predictive test. However, there have been suggestions (Ellestad, 1980\(^2\)) that predictive tests such as these can have an error of ± 15 percent which may have resulted in a non-statistical difference. Another factor might be the difference in experimental protocol between the two experiments.

Cureton's results (1972\(^2\)) with regard to reaction time are similar to the results of this study. He found that the group taking octacosanol lowered (RT became quicker) total body reaction time tests more than the group taking synthetic vitamin E — the results were statistically significant at the 0.05 level. Similarly he found that physically active 10 to 13 year old boys showed significantly reduced reaction times after ingestion of octacosanol and in the total body vertical jump reaction time tests the advantage was markedly in favour of the octacosanol supplemented subjects.

Reaction time is a function of the neuromuscular system; the time it takes the system to get “warmed up” and pass the nervous impulse from one part of the system to another. Cureton (1972\(^2\)) suggests that dietary supplements exert their favourable influence on endurance via an improved functioning of the nervous system rather than changes in the oxygen transport system. It is suggested that improvements in reaction time might be brought about by improvements in the nervous rather than the muscular system.

A number of factors have been suggested which will influence reaction time. Among these are foreperiod, complexity of the desired response, complexity of the stimulus, intensity and duration of the stimulus, practice, attention, distraction, fatigue and particular sense organ stimulated. In particular for response to a visual stimulus, in daylight or illuminated conditions, the reaction time becomes longer, the greater the distance of the stimulation from the fovea. In summary, it was hypothesised that octacosanol reduces reaction time through facilitating improved functioning of the nervous system as part of the neuromuscular system rather than the muscular portion of that system, although the exact nature of that improvement is not known.

In conclusion this experiment has demonstrated that octacosanol can in fact lead to

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improvements in some aspects of physical performance. These improvements however, do not appear to be as widespread as has been advertised. Clearly, further work needs to be undertaken to determine the exact nature of the improvement brought about by octacosanol and also to determine whether octacosanol affects other parameters of performance, for example anaerobic performance or maximal aerobic performance.

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REFERENCES