

New dietetics for the man under exertion

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The mountain of articles, publications and statements on the subject of his diet leaves the athlete, whether he is merely an amateur or a top-level runner, completely confused. It is a fashionable subject which had led to an increase in the myths and false science which are prejudicial to objective information...

In this article, which is necessarily limited, we are going to try to deal with this important problem by referring to the most recent scientific work, borne out by experience in the field.

We do not presume to give a "miracle recipe", but merely to indicate, in the light of objective information, what would appear to be the ideal.

There are two points to be made first of all :

1. The physiology of "the man under exertion" is an expanding science. We should be fully aware that it deals with up-to-date knowledge, likely to change to keep in line with progress made in research in this field.
2. The athlete's diet is an extremely vast subject; it depends on the type of exertion, its duration, its intensity, and the muscles (or rather the muscular fibres) used. We will restrict ourselves therefore to the long distance runner, i.e. distances over 10 km.

In preparing this article, we looked at a large number of reports, articles and works by leading international specialists who have worked on the evolution and requirements in energy substrates during intense exertion over a long period i.e. exertion lasting longer than 60 minutes at 75 % of maximum capacity. These were by the Scandinavians Astrand, Hermansen, Saltin, etc., the Americans Costill, Gollnick, etc., and experts from the Eastern bloc countries, particularly the German Democratic Republic.

We have noted that there is a definite convergence and it is this synthesis that we pass on to you. Before doing so, we would like to make a comment on the supposed differences of opinion which exist between cer-

tain researchers of international reputation. We will give two examples : Astrand remains a staunch supporter of the formula of the Scandinavian dissociated diet (in the second edition of the Handbook of Physiology of Muscular Exercise which has already been published in the United States in 1977, the French translation of which has just been published by Editions Masson) ; he describes at length the whole method and his opinion leaves no room for doubt. We will also give the example of Costill who has introduced, it is true, some variations into the types of diet to which we refer, but whose links with the Scandinavian laboratories are still very strong. He has just spent a year in Oslo, at Lars Hermansen's Muscle Physiology Laboratory, where they carried out research together.

It is all too frequently forgotten that when we speak of the athlete's diet it is not a question of having a rigid programme, but of knowing if the main physiological foundations are correct in order to adapt them to each individual.

Background

As the American physiologist Gollnick recalled at the scientific conference on the marathon (New York, 23rd-28th October 1976), it is the Scandinavian researchers Christensen and Hansen who demonstrated in 1939 the effect of certain types of diet on performance, by highlighting the role of carbohydrates. But the work which was to provide the foundations of modern diets for athletes was carried out in the sixties thanks to the use of the muscular biopsy discovered by the Swede Bergstrom. It is to the team made up of Bergstrom, Hultman, Hermansen and Saltin that we owe the important research carried out on the effect of diet combined with intense exertion, enabling the achievement of an increased stock of muscular glycogen and thereby the possibility of maintaining intense exertion for longer or of improving performances... .

Since then, work in this field has not ceased to develop, thanks to close co-operation between the Scandinavian and American physiology laboratories.

Use by athletes

All the researchers we have mentioned have always taken care to not base their findings solely on laboratory results, but to check the practice of their theories in the field.

It is obvious that they were first used in Scandinavia. Astrand was to recall at the congress in Saint Etienne in 1977 that thanks in part to the use of a high-carbohydrate diet, the result of work by Christensen and Hansen, Scandinavians were the winners a good many times during the fifties and sixties of long distance events, particularly cross-country skiing. Ron Hill above all, at the end of his triumphant arrival in the marathon at the European championships in 1969, was to make the "Scandinavian Dissociated Diet" better known at a time when it was a complete novelty. He told a journalist that it was thanks to this formula that he had been able to leave Roelants behind in the last kilometres.

Since then this type of diet, with variations, has spread far and wide outside Scandinavia, to the United States, into Britain and to a number of the Eastern bloc countries...

In France these methods remained controversial, but it should be noted that the French cross-country skiing team has used them since the 1976 Olympic Games, as have a certain number of marathon runners.

Two congresses have been held in Saint Etienne (in 1977 and 1979), bringing together the world's great specialists in these matters, to try to take stock of the basic principles and make them better known. Even so, there is still much work to be done in spreading information. We have noted many errors in interpretation, or even worse whimsical uses which distort the results. The subject of the athlete's diet is not a straightforward one; it is necessary already to have a good knowledge of the human engine, otherwise contradictions or mistakes are made which could have a direct effect on performance.

Physiological foundations

During exertion, whether it be training or a competition, we are like cars—we need fuel, and it depends on two aspects :

a) *Quality of the fuel*

- glycogen (particularly muscular glycogen) or "high-octane" fuel, used up first during intense exertion (over 70-75 % of our capacity).
- Fats (stored, particularly in fatty tissue) or "low-octane" fuel used as a supplement during intense exertion, or on its own during our normal activities.

b) *Tank capacity*

- "High-octane" or glycogen : very small and almost exhausted after 90 minutes of at 70-75 % intensity (this is one of the reasons for flagging after 30-35 km in a marathon).
- "Low-octane" or fats : extremely large, but with a lower return. This is the fuel which is used when the glycogen is exhausted, but it results in a loss of speed.

IMPORTANT COMMENTS

The reconstitution of the stock of glycogen by the intake of food after exertion is an extremely important point to be taken into consideration. As was perfectly demonstrated by Costill (cf. "A Scientific Approach to Distance Running"), normal foods (with 50-55 % of glucids or carbohydrates) cannot re-establish this stock rapidly, when it has been gradually exhausted by, for example, intensive daily training. It could take several days and is therefore a factor to be taken into consideration when preparing for a competition. Particularly close attention should therefore be paid to the intensity of training in the last two weeks, and the diet should be arranged accordingly. On this point we should also note that well-controlled training encourages the use of fats during a marathon and thus permits an economy of "high-octane fuel", i.e. glycogen.

Diet and Performance

It is thanks to our diet that we are able to reconstitute the reserves of energy which we need in our normal lives or that we have just used up in the course of a physical exertion. Normal diet is intended to meet the requirements of normal life and does not correspond either in quantity or quality to the exceptional requirements of intense, prolonged exertion, whether it be training or competition.

The experiments to which we have referred had as their aim research into the extent to which it is possible to increase the capacity of our tanks for high-octane fuel and thereby improve the performance or duration of exertion.

The first scientific work (1939) highlighted both the role of glycogen and that of a high-carbohydrate diet. However, it was in 1967 in particular that the Bergstrom Team succeeded, after a series of studies, in perfecting a method combining diet and intense training which resulted in a massive increase in the stocks of glycogen.

They demonstrated that if the muscles which were to be used during a long period of exer-



A rule which is not widely known : the meal before exertion should be light.

tion were first exhausted, it was possible to increase our stocks of glycogen and thereby continue a high-speed exertion for longer (which is what happened for Ron Hill, for example). This "overcompensation", as the Americans called it, was achieved by high-carbohydrate foods in the days before a competition, after having exhausted as much as possible the reserves of glycogen by intense exertion. It is this combination of diet and training which allows the massive increase in the stocks of glycogen, that is the high-octane fuel of our bodies.

The results achieved in the laboratory on human subjects give results in figures which speak for themselves. Expressed in minutes,

they show the length of time during which the subjects were able to exert themselves to complete exhaustion at 70 % of their maximum capacity. Different types of diet were tested during the days preceding the experiment, and the following table shows the results of this.

- Proteins + fats : 60 minutes.
- Normal balanced diet : 115 minutes.
- High-carbohydrate diet : 170 minutes.
- Scandinavian dissociated diet: 240 mi-

A very large number of international specialists use, with variations, the formulae we

| | Scandinavian dissociated diet | | High-carbohydrate diet with exhaustion of stocks of glycogen | |
|--|-------------------------------|----------------|--|----------------|
| | Diet | Training | Diet | Training |
| Sunday (1) | Normal | 3 hours | Normal | 3 hours |
| Monday (2) | Proteins Lipids | 1 hour | Normal | 3 hours |
| | | | Lipo-protein dinner | |
| Tuesday and Wednesday (3 and 4) | Proteins Lipids | ½ h. - 2 hours | Carbo-hydrates | Light training |
| Thursday and Friday (5 and 6) | Carbo-hydrates | Rest | C a r b o - hydrates | Rest |
| Saturday (7) | Carbo-hydrates | Rest | Carbo-hydrates | Rest |
| | Normal dinner | | Normal dinner | |
| Sunday (8) | Normal breakfast | Race | Normal breakfast | Race |
| | | | | |

have described and this is no doubt the reason for both the improvements in times which have been achieved by men and women and the fresh state in which runners arrive nowadays.

Finally, we will make a remark which will situate the problem well by recalling that at the last New York marathon the Norwegian Grete Waitz achieved almost the same time in the second half of the marathon as in the first. We think that no comment is needed. One element which seems to us to be essential in order to understand part of the mechanism properly is the following :

The consumption of glycogen by our bodies is practically constant while we have available even small reserves. The role of the manipulation of our diet to increase our reserves will therefore come into play during the last part of a marathon, particularly after the 30/35th kilometre and of course at the end of the race. The time lapse required for reconstituting or increasing one's stocks of glycogen, i.e. at least three days of a high-carbohydrate diet, should be borne in mind at all times.

Different types of diet

We will recall briefly the foundations of human diet, apart from vitamins and minerals such as calcium, iron, etc., which also have an essential role to play in our biological equilibrium :

- Proteins : indispensable as muscle building material, even if they are not normally used as a fuel during usual exertions.
- Fats or lipids : the fuel of our daily lives.
- Carbohydrates or glucids: source of muscular and hepatic glycogen and blood sugar.

It is the wonderful metabolism of all these elements which ensures our life and equilibrium.

Relying, as we said at the beginning, on a study of numerous works, publications made at scientific congresses and recommendations made by specialists in the preparation of athletes (particularly for the next Olympic Games), we are going to attempt to describe certain types of diet, setting out the basic components (as percentages of the total number of calories).

Normal balanced diet (according to level of physical activity) :

- Proteins 13 %.
- Fats 25-35 %.
- Carbohydrates : 52-60 %.

(It should be noted that the percentages given for proteins and fats are taken from the recommendations of the WHO and are in practice adopted by all countries. Such a breakdown cannot be really classed as a true athlete's diet.)

Athlete's diet (recommended in many countries. This is of course a diet to be used during intensive training, i.e. twice a day) :

- Proteins 13 %.
- Fats 26 %.
- Carbohydrates 61 %.

High-carbohydrate diet :

- Proteins 17 %.
- Fats : 7 %.
- Carbohydrates 76 %.

High-carbohydrate diet (with previous exhaustion of stocks of glycogen—see table) :

- Proteins 17 %.
- Fats 7 %.
- Carbohydrates 76 %.

“Scandinavian dissociated diet” type of diet (see table) :

- Lipo-protein phase :
- Proteins 20 %.
 - Lipids 70 %.
 - Glucids 10 %.

- Carbohydrate phase :
- Proteins 17 %.
 - Fats 7%.
 - Carbohydrates 76 %.

IMPORTANT RECOMMENDATIONS

We give here some essential rules which are too often overlooked :

1. Simple sugars (table sugar, sweetened drink, glucose, etc) should never exceed 10 % of the total number of calories.
2. Special diets (high-carbohydrate or “Scandinavian dissociated”) should never constitute a normal diet, but be reserved for exceptional conditions (important competition). It is indispensable to experiment with them beforehand at less important events.
3. All the high-carbohydrate diets demand a greater intake of liquid (at least an extra 1 ½ litres). Each gramme of carbohydrate fixes 3 grammes of water and it is therefore vital to provide this extra liquid. An easy way of checking this type of diet is

- by weighing oneself. Using this formula, one should put on 2-3 kilos. The excess of water will disappear during exertion. Moreover it constitutes a good reserve that can be used during a marathon, particularly in warm weather; it will limit dehydration, which is a important risk factor for our bodies and in diminished performance.
4. It is always recommended to have diet programmes drawn up by a doctor or a dietician to take into account vitamin and mineral trace requirements. There must be a correct division of requirements in calories between the different percentages (a foodstuff is not composed solely of glucids or carbohydrates, but also of fats, proteins).
 5. There is no contra-indication for an insulin-dependent diabetic taking part in a marathon-type effort, but it obviously requires particular attention to be paid to certain dietary problems. It is therefore useful to discuss this beforehand with a medical specialist. In theory, it is preferable for a diabetic not to apply the formulae strictly which we have discussed, but complete treatment of this subject would be too involved.
 6. For the last meal, the day before the race, it is possible to choose a breakdown of one's own choice since it is no longer of any importance with respect to the storage of glycogen. However it is still a good idea to remain within reasonable limits. We have said absolutely nothing about what happens in respect of diet on the day of the competition. We will merely say that the last meal should be taken at least three to four days before starting, and should be extremely light.
 7. We have not taken into account in the caloric breakdown of the various types of diets the part represented by alcohol in all its forms (wine, beer, etc.).
 8. It is the "Scandinavian dissociated diet" which, in most cases (the physiology of man is very complex and certain subjects may react differently), gives the best results. It includes during the first "intense exertion + lipo-protein diet" phase psychological restraints which in some cases are considerable. They call for an effort of will; it is up to the athlete and the coach to decide by drawing up a balance of its positive and negative aspects.
 9. There has been much talk of digestive or other problems which may arise in the use of some of these diets. We would recall that at the congress in Saint Etienne which was held in July 1979 and which covered all the problems of diet, the international experts who took part in this scientific meeting were unanimous in declaring that to their knowledge nothing serious had ever appeared in all the time it had been practised, which is more than ten years now. Costill even said that he knew some marathon runners in the United States who use a high-carbohydrate diet very regularly during the competition season when they are taking part in many marathons, and that they have not had any trouble of any kind.

SUMMARY

The author describes the athlete's diet on the basis of the most recent scientific works. The athlete's nutrition depends on the type of exertion, its duration, its intensity, and which muscular fibres are used. This study is limited to the needs of the long-distance runner in energy substrates during intense exertion (75 % of oxygen consumption) of long duration (longer than 60 minutes).

The most interesting discoveries concern the role of the stocks of glycogen. The higher these are, the longer the exertion can be continued at a high speed.

The reconstitution of the stocks of glycogen by means of a high-carbohydrate diet after exertion is an extremely favourable element for rapid recuperation, training or competitions at short intervals possible.

The last important point concerns the breakdown of the different nutrients in man under exertion. It is considerably different from the diet consumed by the average Frenchman. This breakdown gives a much larger proportion of carbohydrates :

- Proteins : 15 %.
- Lipids : 25 %.
- Glucids : 60 %.

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