IAAF @-*Letter*

for CECS Level II Coaches

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SPECIFIC THEME: History and methods of tapering

GENERAL THEME: What exercise physiology and training science say about tapering

Specific Theme

HISTORY AND METHODS OF TAPERING

1 History of tapering

According to Noakes (1991, pp. 136-152), the first one who described the importance of resting before a major race (tapering) was Arthur "Greatheart" Newton, whose competitive career spanned 13 years, from May 1922 to June 1935. During that time he won five of the six 90-km Comrades Marathons that he entered. In his day, Newton was described variously as "the most phenomenal distance runner the world has ever known", "one of the marvels of all time", and "the greatest runner ever seen." Newton wrote: "You should cut out all racing of every description during the last month of your training; … you will need certainly three weeks to put the finishing touches to your stamina and reserve of energy …. When you consider what a vast amount of work you have already gone through you will admit that a fortnight or so longer is a relatively trifling matter. Endeavour to keep all your spare time fully occupied with reading, writing, or anything that will keep you still – anything to divert your mind from harping on the forthcoming event."

Certainly Alf Shrubb, who was born on December 12, 1878, 4-1/2 years before Newton, and who set amateur and professional world records at distances from 2-5 miles and from 8-11 miles, including the record for the greatest distance run in 1 hour, trained hard right up to the day of competition; 4 days before he set his 16-km and 1-hour world records, he ran a 16-km time trial in 50:55, just 15 seconds slower than his subsequent world record! Shrubb was successful even though he did not taper, probably because he was remarkably gifted, because he was not a heavy trainer, or because he did not race distances longer than 18 km.

From this it can be concluded that the harder the athlete trains and the longer the distances he or she races, the more vital the tapering process.

Other distance runners of the day were unaware of the importance of tapering. The day before the 1912 Stockholm Olympic Marathon, the South African who finished second in that race, Christian Gitsham, set out to run the complete marathon distance. Fortunately, his coach caught up with Gitsham after he had run 20 km and angrily returned him to his hotel. Eleven days before the 1920 Antwerp Olympic Marathon, the team of four United States runners ran the course in 2:46:55, a time they could barely repeat on race day.

After World War II, it was Franz Stampfl, coach of the British running greats Brasher, Chataway, and Bannister, who brought up the topic of resting before competition again. He insisted that his distance athletes rest for 4 full days before competition (1955, p. 72). But it was really the swim coach Forbes Carlile (1963) who first emphasized the importance of tapering before competition: "The important *principle* is that after a strenuous two or three months of training there should be a very distinct easing of hard training and an introduction of more rest starting from about *three weeks before important events* …." (p. 32)

At the end of the first week of tapering, the swimmers would complete a time trial. "A poor time generally indicates that the swimmer needs *more* rest." (Carlile, 1963, p. 33)

Today runners are beginning to realize the importance of an adequate taper. Frederick (in Brown, Burke, Falsetti, Frederick & Ryan, 1983, p. 98) used the term "Zatopek phenomenon" to emphasize the importance of resting before competition. The author relates that Emil Zatopek was training very intensively for the 1950 European Games in Brussels when he became so ill that he required hospitalization for two weeks. He was released only two days before the 10,000-m race, which he won by a full lap, thanks to the enforced rest. A few days later, he won the 5,000-m race by 23 seconds (see also Anderson, 1992).

Other famous examples exist. Dave Bedford set the 10,000-m world track record in 1973 after injury kept his training to a minimum for some months. Toward the end of 1973, Derek Clayton ran a 2:12 marathon after one of his "easiest preparations" Four months later he failed to complete the 1974 Commonwealth Games Marathon due to injury. "I think," he later wrote, "there is a message here as I often thought I trained harder than necessary." (Quoted by Noakes, 1991, p. 152)

2 How to taper properly

A proper taper should leave the athlete at a physiological and psychological peak. The blood volume will be increased, as would be the concentration of red blood cells, fuel storage, strength and lactic production will be reduced. Mentally the athlete will be feeling sharp, confident, motivated, allowing full concentration on the task ahead.

During a taper, several variables can be manipulated in an attempt to maximize performance. These include

- the frequency,
- duration and

- intensity of training sessions,
- and the duration of the whole taper period.

So far there has been no systematic study of any of these variables, but from the existing research some factors emerge as being important to a successful taper.

According to Hawley (2002), most research now advocates a taper of between 7-20 days. Obviously the longer the race, the longer the taper that is required. But a minimum taper of ten days is recommended. The optimal amount of time to taper depends on:

- the athlete's level of fitness,
- the distance the athlete will be racing,
- how hard the athlete has been training.

The higher the athlete's level of fitness, the longer the taper can be. If the athlete is fairly new to training then a long taper may lose some of his fitness, so he should stick to a shorter taper.

Too short a taper will leave the athlete tired on race day, while tapering for too long will eventually lead to a loss of fitness. Considering that any one workout can give the athlete far less than a 1% improvement in fitness but that a well-designed taper can provide a much larger improvement in race performance, it is probably wise to err on the side of tapering too much rather than not enough.

The best numbers of days to taper for the most popular race distances are as follows:

Marathon: 19-22 days

15 km to ½ Marathon: 11-14 days

5 km to 10 km: 7-10 days.

The scientific evidence clearly indicates that the key to effective tapering is to substantially cut back one's mileage, but to maintain or even slightly increase the intensity of one's training (see Hawley, 2002). The maintenance of training intensity (i.e. quality) is necessary to avoid detraining, as long as reductions in other training variables allows for sufficient recovery to optimize performance (see *The truth about tapering*, 2003).

Results from a study of competitive cross-country and middle-distance runners training approximately 80 km/week revealed that these subjects improved their performances more when they followed a low-volume, high-intensity taper for 7 days compared to a low-volume (30 km/week) low-intensity taper or no running at all (see Shepley, MacDougall, Cipriano, Sutton, Tarnopolsky & Coates, 1992). Of interest was that the low-volume, high-intensity taper (which consisted of between 3-5 x 500 meter repetitions in 70-75 seconds with 6-7 minutes recovery between runs) resulted in a total weekly running volume of less than 10 km!

This means that reducing the amount one runs has the greatest impact on reducing accumulated fatigue to improve one's racing performance. The optimal amount to reduce training is still open to debate. A guideline could be that a marathoner would reduce his training in the third week before the race by about 20%, in the second week by about 40% and in the race week by about 60%. A 5-10 km run-

ner would start to reduce his training only in the second week before the race by about 20% and in the race week by about 50% (see Pfitzinger, 2003).

So the reduction depends on both the racing distance and on the length of the taper period: When on a longer taper, volume should be reduced 20% per week, on a 14 day taper the reduction should be 30% per week and if on a 10 day taper, there should be a reduction by 50%.

High training frequencies (at least 80% of pre-taper values) seem to be necessary to avoid detraining in highly-trained athletes – especially in the more technique-dependent events (see *The truth about tapering*, 2003). Thus, the training reduction during the taper should best be completed per session rather than dropping sessions. This keeps the training frequency the same and maintains a "feel" for the activity.

In terms of intensity there should be two sessions per week at an above race pace effort, with usually a race type session the Sunday before the big race. The other sessions would be at no more than 75% effort, but would include short bursts at or above race pace effort to maintain the motor pathways required for racing (see Hawley, 2002; Pratt, 2003).

A peak level can only be maintained from four to six weeks depending on the athlete's level of base fitness and a taper like this should only be done two or three times a season for the most important races (see Pratt, 2003).

3 What to do

If an athlete's total mileage is less than 50 miles a week and the event is less than one hour, then the athlete should

- taper for 7 to 10 days,
- reduce the total mileage by 80%,
- perform his high-level interval sessions at 90% of VO_2max,
- reduce frequency of training by 20% (see Mackenzie, 2004).

If his total mileage is greater than 50 miles a week and the event is greater than one hour, he should taper for 14-20 days.

4 Other key points and recommendations for the taper

The following key points are also important prerequisites for effective tapering:

- Glycogen energy stores take 2-3 days to be replaced after exhaustive aerobic exercise.
- No exercise in the 48 hours before events is associated with glycogen overload and muscle cramps in some athletes.
- Muscle power is reduced by strength training for 2-3 weeks after maximum workouts.
- Eccentric exercise, which occurs when muscles lengthen under tension, is especially damaging to muscles. This is for example characteristic of some weight work and running. For this reason runners may need more of a taper than for example cyclists.

- Endurance lasts for at least 10 days – more likely 2 weeks.
- Maximum aerobic capacity lasts for a few days – perhaps a week.

This leads to the following additional training rules:

- The last endurance effort should be 7-10 days before the event.
- Exhaustive aerobic exercise should be avoided for at least 3 days prior to the event.
- Maximum weight and strength work should eliminated for at least 3 weeks before the event.
- Unaccustomed eccentric exercise should be avoided.
- Aerobic intervals should be continued until 3-7 days before the event. The number of intervals should be reduced by one third.
- Athletes should rest passively or actively (easy running) 2 days before the event.
- They should warm up the day before the event to near event intensities.
- They should reduce frequency of training by 20% (see Mackenzie, 2004).

If his total mileage is greater than 50 miles a week and the event is greater than one hour, he should taper for 14-20 days.

DON'Ts and DOs about TAPERING in Distance Running

(according to Lawrence & Scheid, 1984, pp. 62-63, and Noakes, 2003, p. 321)

DON'Ts

- DON'T try to force your training during the last five days to make up for what you feel are deficiencies.
- DON'T make the common mistake of trying to "sharpen up" with speed work during your taper. A last-minute speed workout will simply flatten you for several days and leave you with no "snap" in your legs for the race.
- DON'T try to maintain your normal weekly mileage during the last days before a major competition.

DOs

- DO begin a slow reduction in the intensity and – most importantly – in the quantity of your workouts before a major competition. This gradual easing up will allow your body to disperse the residual fatigue products that have been carried from one workout to another.
- DO as little training during the taper as your mind will allow, but do that little training at a fast pace.
- DO include one last quality workout not more than seven and not less than five days before major competition. As the endurance runner becomes more seasoned and experienced, the last quality training session can be moved closer to the competition.
- DO take a day off before major races.
- DO concentrate on getting adequate rest and sleep on the days before competition. A very effective way of ensuring your rest is the following: Before a major race on Saturday, Thursday is taken as a complete rest day and then a very light workout is done on Friday. This schedule has two benefits: First, using Friday as an "active rest day" takes care of apprehensions and minor worries, and then light exercise helps sleep better. Second, it must be remembered that there is a two-day lag in the training effect – that is, a hard workout seems to affect you more the second day. Resting two days before the race turns that two-day lag into a valuable asset. You have time to feel the full benefits of your rest.

General Theme

WHAT EXERCISE PHYSIOLOGY AND TRAINING SCIENCE SAY ABOUT TAPERING

1 Definition of 'tapering'

Peak performance requires maximal physical and psychological tolerance for the stress of the activity. But periods of intense training reduce muscle strength, decreasing the athlete' performance capacity. For this reason, to compete at their peak, many athletes reduce their training intensity prior to a major competition to give their bodies and their minds a break from the rigors of intense training. This practice is referred to as tapering (Wilmore & Costill, 1999, p. 396).

Taper is the term commonly applied to the short-term reduction in training load before competition (Gibala, MacDougall & Sale, 1994, p. 492). The aim of the taper is to reduce the physiological and psychological stress of daily training and optimize sports performance (see *The truth about tapering*, 2003).

The taper period, during which intensity is reduced, should provide adequate time for healing of tissue damage caused by intense training, and time for the body's energy reserves to be fully replenished (Wilmore & Costill, 1999, p. 396).

2 Changes during the taper period

The most notable change during the taper period is a marked increase in muscle strength, which explains at least part of the performance improvement that occurs. It is difficult to determine whether strength improvements result from changes in the muscles' contractile mechanisms or improved muscle fiber recruitment. However, examination of individual muscle fibers taken from swimmers' arms before and after 10 days of intensified training did show that the fast-twitch fibers exhibit a significant reduction in their maximal shortening velocity. This change has been attributed to changes in the fibers' myosin molecules. In these cases, the myosin in the FT fibers became more like that in the ST fibers. From this it may be assumed that such changes in the muscle fibers cause the power loss that is experienced by swimmers and runners during prolonged periods of intense training. It can then be also assumed that the recovery of strength and power that occurs with tapering might be linked to modifications of the muscles' contractile mechanisms.

Tapering for competition is crucial to an athlete's best performance. Training damages the body, so reduced training volume and intensity, coupled with quality rest, are needed to allow the athlete's body time to repair itself and to restore its energy reserves to prepare the athlete for competition.

3 Scientific evidence

Although tapering is widely practiced in a variety of sports, many coaches fear that reduced training for such a long period before a major competition will cause a loss of conditioning and poorer performance. But numerous studies clearly show that this fear

is unwarranted. Developing optimum maximal oxygen consumption initially requires a considerable amount of training, but once it has been developed, much less training is needed to maintain VO_2max at its highest level. In fact, the training level of VO_2max can be maintained even when training frequency is reduced by two thirds.

Runners who reduced their training by about 60% (from 84 km per week to 24 km per week) for 15-21 days showed no losses in VO_2max or endurance performance, nor any significant changes in heart-rate response during submaximal running. They did, however, show an improvement of about 5% in leg power, calculated from a vertical jump test (Wilmore & Costill, 1999, p. 396).

In a study with 24 male (n = 18) and female (n = 6) distance runners who had trained a minimum of 48 km/wk for at least the previous two years, Houmard, Scott, Justice & Chenier (1994) found that the optimally reduced training schedule for improving performance in distance runners appears to involve an even more substantial (85-90%) graded reduction in training volume and daily high-intensity interval work during a relatively short (~7 days) period.

That a greater reduction in training volume results in better performances than a smaller reduction is also confirmed in a study by Mujika, Goya, Padilla, Grijalba, Gorostiaga & Ibañez (2000, p. 516). In eight well-trained male middle-distance runners better 800-m performances were achieved when training volume was progressively reduced by 75% than by only 50%. Mujika et al. also found significant hematological changes in the runners. These changes suggested an increased erythropoiesis. Low-intensity continuous training and high-intensity interval training, which were combined during the taper, could have elicited distinct physiological responses. The former seemed to facilitate erythropoiesis, but increasing the volume of this type of training was associated with high plasma creatine kinase levels and lowered lymphocyte count and total testosterone. High-intensity interval training, on the other hand, seemed to increase hemolysis, but stimulated circulating total testosterone concentration.

In their study with nine highly trained middle-distance runners, Shepley et al. (1992, p. 706) also arrived at the conclusion that runners can improve their performance as a result of a taper where intensity is maintained and volume greatly reduced. They suggest that the improvement may be due to increased oxidative enzyme activity and/or increases in blood and red cell volume.

The study by Neary, Martin, Reid, Burnham & Quinney (1992) with endurance cyclists confirms these findings. They found positive changes in glycogen storage and oxidative enzymes, as well as a higher power output at the ventilation threshold (broadly speaking, the highest rate of work which can be maintained submaximally) following a four-day and eight-day taper (p. 30).

4 Types of taper

Four different types of taper have been described and used:

- Linear taper, in which the training load is reduced progressively in linear fashion.
- Exponential taper (slow decay), with a relatively slow non-linear decline in load.
- Exponential taper (fast decay), in which the rate of decline is faster.
- Step taper – a non-progressive standardized reduction of training load (i. e. daily mileage is suddenly dropped and then held constant thereafter).

Of these, progressive non-linear techniques seem to have a more pronounced positive impact on performance than step-taper strategies (Banister, Carter & Zarkadas, 1999).

All this evidence shows that smart cutbacks in training can only yield good results. As long as the workouts are fairly intense, athletes can maintain their fitness on a greatly reduced volume for at least three weeks with no problems.

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