



## **Additional Thoughts on Nutrition for Racing**

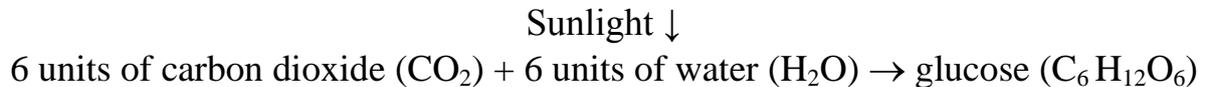
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I was interested in Dr Colin Walker's recent article entitled "Practical Feeding for Performance" in the October 15th issue of the RP Digest. His science-based approaches combined with his extensive experience produce articles of great value to pigeon fanciers. His recent article took me back to the days of my own experiences with feeding for breeding as well as for racing performance in the use of combinations of mainly peas, corn, wheat and barley for these periods in the lives of my pigeons. In one example from that time, like other fanciers I believed in the high value of maple peas over other varieties of peas – part of the dogma that continues to persist in the sport to this day – until a friend who is a specialist in pulse crops recommended that I should reduce or eliminate maples from the diet of my pigeons. The reason: the brown coat of maples contains a significant amount of an anti-trypsin compound that interferes with the digestion of protein. Trypsin, which is produced in the pancreas and released into the intestine, is an important enzyme in the digestion of protein, and high levels of maples in a ration can have a significantly negative effect on the digestion of protein. As a result, her suggestion was that maples should be eliminated from a ration, or reduced to perhaps a maximum of 5-10% of a ration. To make up the difference in the supply of protein, other varieties of peas, etc. can be substituted for the decreased levels of maples.

These initial remarks introduce the point that, as in other domestic species, nutritional and other information about pigeons has continued to modify and evolve over the years. (I know, I know – the views of some fanciers will continue to be mired deeply in the "beans/peas-only-for-racing" dogma and they may well not change their views in spite of the facts!) Accordingly, in this article I thought it might be useful for racing fanciers if I were to explore some of the interesting current approaches and suggestions concerning pre-and-post racing nutrition to supplement the information provided by Dr Walker.

As background at the outset, it is important to emphasize the fact that the chief fuel for both racing pigeons and migratory birds is unquestionably FAT, stores of which are produced in pigeons primarily from glucose (also known as dextrose) derived from the feeding of cereal grains and seeds. Firstly, some basic facts on this point. In plants, glucose, a major carbohydrate in nature, is produced from carbon dioxide and water in the presence of sunlight, as follows:



In plants and their seeds, glucose is stored in the form of starch which actually consists of two slightly different structures, both of which are comprised of many units of glucose linked together in different biochemical configurations. The first of these structures is amylose, a single unbranched chain of several thousand units of glucose that make up 20-30% of starch. The other one is amylopectin – one of the largest molecules found in nature - a highly branched structure containing up to one million units of glucose that form the remaining 70-80% of starch. (It is interesting and notable that corn, milo, paddy and white rice, and millet contain only amylopectin and thus, are of good quality. By contrast, wheat, barley, oats and canary seed are high in amylose and are of lesser quality.) When starch is digested in the intestines, units of glucose are freed and are then absorbed across the wall of the intestines into blood vessels that distribute it to tissues – including the liver - throughout the body. In the next step, glucose may be used immediately as a source of energy, or it may be transported to both liver and muscle where it is linked together in its complex, highly branched storage form known as glycogen.

Structurally, glycogen in the liver and muscles of pigeons and other animals is somewhat similar to amylopectin found in plants but it is much more highly branched than amylopectin - like the many branches of a tree - a fact that has enormously significant consequences for animals. For instance, in plants, an unbranched chain like amylose has only two ends from which the units of glucose can be detached when energy is needed, whereas in animals like pigeons, a highly branched structure like glycogen has countless ends from which glucose can be released. The greater the branching, the greater the number of ends from which glucose can be liberated, and the faster the glucose can be metabolized in the production of energy. For instance, in pigeons during the explosive launch phase of flight, or when sudden dodging bursts of speed are needed during level flight for example, limitless units of glucose can be released simultaneously from the ends of the many branches in glycogen for these very energy-demanding events.

Equally importantly in pigeons is the crucial conversion of glucose to fat (in the form of fatty acids) in the liver and their transport in the blood stream to the red fibers in the breast muscles as well as to storage depots (where they are assembled in the form of solid fats, also known as lipids or triglycerides) primarily in the body cavity among the intestines. Of significance to racing fanciers is an

important US study that demonstrated the key role of glucose in the production of fat for flight in pigeons. The results showed that intravenously injected glucose that was tagged with a radio-active label (attaching a radio-active label to the glucose allowed these scientists to track the glucose and determine its fate in the body), was incorporated into fatty acids in the liver within three minutes in hungry young pigeons, and that the content of fatty acids in liver reached a plateau in 15 minutes. Significant appearance of fatty acids in blood and fat depots was also first evident at 15 minutes after the injection, and their concentration rose continuously throughout the two-hour experimental period. During this trial, the authors calculated that the liver was converting glucose to fatty acids at a rate 25 times faster than was occurring in the fat depots. This study concluded that depot fat in pigeons does not have the capacity for the conversion of glucose to fatty acids compared with that of the liver. It also confirmed the fact that the regulation of fat production from glucose in pigeons occurs in the liver.

As fat is required during flight, it is mobilized from body depots by the action of the enzyme lipase that splits the fat into fatty acids and glycerol. In order that they are soluble in the liquid medium of the blood, the liberated fatty acids are attached to the protein albumin and are transported to the liver and the flight muscles. Thus, during flight this mobilizing process decreases the supplies of fat in storage areas while it increases the level of fatty acids in the blood stream, liver and breast muscles. In pigeons during the first stages of flight, a period of 1-2 hours is required to attain a high and stable contribution of fat for extended flight. Within the red fibers of the breast muscles, fat is metabolized to produce the energy required for prolonged flight. As a result, within the second hour of flight and beyond, fatty acids from the body fat depots are now supplying up to 90% of the energy for prolonged flight, thus sparing further use of valuable glucose from the metabolism of glycogen as a fuel for sustained flight.

Having looked briefly at glucose and fat as sources of energy for the daily life of pigeons, and importantly for sustained flight, surprisingly it is also necessary to examine the role of protein, especially as it pertains to flight. Proteins from the diet are important because they supply the essential amino acids and during metabolism, they contribute to the production of glucose, fat, energy, and several vitamins. Proteins are also the primary constituents of many tissues -- bones, ligaments, feathers, skin, muscles, and various internal organs. They make up the structure or framework of all body organs, and in addition they are used during the racing season, for example, in the maintenance and repair of muscle damaged or degenerated in racing, as well as in the production of energy during flight - albeit only 10-15% of that energy.

Proteins are composed of smaller units known as amino acids that characteristically contain nitrogen. There are 22 different amino acids that, in different combinations, comprise a variety of proteins. It is important to note that not all of the 22 amino acids are present in every protein. Because of this fact, it

becomes evident that some proteins are of very high quality, and others are of low or poor quality. The important message here is that the very high quality essential amino acids must be supplied in the diet. By contrast, lower quality nonessential amino acids are those that can be produced in cells of the body, and need not be supplied in the diet. For convenience, the essential and nonessential amino acids are listed in the following table:

<b>Essential Amino Acids</b>	<b>Non Essential Amino Acids</b>
Arginine	Alanine
Histidine*	Asparagine
Isoleucine	Aspartic Acid
Leucine	Cystine
Lysine	Cysteine
Methionine	Glutamic Acid
Phenylalanine	Glutamine
Threonine	Glycine*
Tryptophan	Hydroxyproline
Valine	Proline*
	Serine
	Tyrosine

\*Birds can produce the amino acids glycine, histidine and proline – considered essential for growth - but not in sufficient amounts at times to meet demands.

In the production of a particular protein in the body, amino acids that are obtained during digestion from the breakdown of proteins present in feed are linked together in sequences that are pre-programmed by body cells. If even one essential amino acid is missing from the diet, the production of any protein requiring that amino acid is halted. This is exactly why the quality of the protein in feed is so important. A feed with high quality protein is one that contains a high proportion of essential amino acids, whereas a feed with lower quality protein is one that is deficient in perhaps several essential amino acids. For this reason feeds such as hemp seed, soy beans, flax (linseed), rapeseed (canola) and peanuts, for example, contain

high quality proteins (that are also more digestible than other common sources of protein for pigeons). Meatmeal and fishmeal used in some pelleted feeds also contain high quality protein.

Now, in terms of diets for racing, where is this preamble on nutrition – particularly that related to protein - leading? Well, some experts in the nutrition of racing pigeons have proposed the idea of reducing levels of various peas – to about 10% - from the breeding and racing diets of pigeons, and replacing them with other important high quality protein feeds such as those mentioned previously. To explain, at the onset of flight, racing pigeons use carbohydrates (glucose derived from stores of glycogen) during the launch phase, but for prolonged flight they rely on fat as the most important fuel for working muscle. Fat is the most concentrated form in which energy can be stored in the body. However, it is very important to note that tissues like the brain, the retina of the eye and central areas of the adrenal glands can use only glucose as a source of energy. Research has indicated that during flight, pigeons utilize certain reserves of protein to help supply glucose for these tissues. Firstly, it is important that the liver release a high level of glucose to the blood stream to supply the brain, retina of the eye and adrenal glands with energy. Food in the intestines is one source of glucose from digested carbohydrates, but because the brain, muscle and other tissues are constantly withdrawing glucose from the blood stream, the blood level of glucose would fall sharply between feedings. This situation is prevented by the liver which stores glucose in the form of glycogen, and releases the glucose from the breakdown of glycogen into the blood stream when it is needed. One important additional source of glycogen for the liver is certain of the amino acids such as alanine, etc., that are readily converted to glucose. Thus, one of the key roles of protein in flight is to provide those highly important amino acids that are readily converted to glucose in the liver to help supply energy to the specialized tissues mentioned previously.

Now, is there any supporting evidence that protein is utilized for this process during flight? Indeed there is. In birds, when protein is metabolized, the end product is uric acid that is seen commonly as the white tip on normal droppings. Research has shown that in pigeons during a race, blood levels of uric acid increase markedly, indicating the accelerated breakdown of proteins to their amino acids. As mentioned, some of these amino acids, like alanine, appear to be useful for the production of glucose. This finding could also account for the higher values of glucose in the blood stream of pigeons flown beyond 5 hours, as amino acids from this evident breakdown of protein are utilized in the production of glucose to fuel the brain, etc.. These amino acids are also used to help restore components of the highly important Citric Acid Cycle in which fat is metabolized for energy in the red muscle fibers – since these components are being constantly drained away during flight. These facts make it abundantly clear that there is an exceedingly important role for protein in the pre-race nutrition of racing pigeons, regardless of the distance to be flown.

Now, what about pigeons that have returned from races? Significant damage to the flight muscles has been reported in migratory Canada geese and some species of shore birds, especially young birds. It is also known that similar changes may also occur in racing pigeons. Races held throughout the season, and especially those in which pigeons experience strong headwinds or other difficult conditions that prolong the hours on the wing, may cause damage to these powerful muscles. It has long been felt that lactic acidosis was the main cause of such damage. However, studies in humans have indicated that, rather than increased levels of lactic acid as the cause of damage and pain, it is microscopic muscular tears that cause the problem. Whether such tears are the also the cause of muscular damage in pigeons is not yet known. In any case, it is always prudent for fanciers to assume that although returning pigeons may appear normal or relatively so, they may have developed some level of muscular damage from the strains of racing. On his website and in a recent Digest article, Dr Walker has described the highly interesting saga of a Janssen- van Loon hen that won an important long distance race, after which she developed signs of muscular paralysis that he treated successfully over several days.

The use of high quality protein grains/seeds soon after the birds arrive home from a race can be helpful in aiding the important repair process in flight muscles. Feeds such as hemp, toasted (cooked) soybeans, and small amounts of flax (linseed) and canola (rapeseed) plus a high quality livestock pellet as suggested for the pre-racing period can supply the high quality protein required in the repair process. Are there facts that support this approach? Indeed there are. Research in pigeons has shown that these repair processes in the flight muscles appear to last only a very short time – actually, not more than 24 hours! Thus, this research highlights the need to intervene quickly after a race to bring about effective repairs to potentially damaged breast and other muscles.

In summary, as the foregoing studies have indicated, the level of high quality proteins derived from the feeds mentioned previously should be increased in the diet both before and immediately after a race. It is also very helpful to be aware of the importance of these feeds for their wide range of amino acids in the production of a further source of glucose for specialized tissues such as the brain, etc., as well as in the maintenance and repair of all tissues - including the breast muscles.