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## WATER IN THE DIET CLASSIFICATION, PROPERTIES AND UTILIZATION OF THE DIFFERENT MINERAL WATERS

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### INTRODUCTION

From recent inquiries it's become evident that some sportsmen refuse to drink water before and during sporting exercise, various students don't eat breakfast before examinations in order to avoid going to the toilet, some people don't drink before sleeping because they're afraid of getting up during the night and, finally, others don't drink in the car while they're on the highway to avoid stopping at the road service.

It's clear that too many people ignore the fundamental role played in the functioning and balance of the biological system of living organisms, showing that they don't know to drink with cleverness to improve their own performance psycho-physical!

The human body is designed for 60-70% water, while the newborns' physical composition requires 75-80%. Therefore, it's intuitive that a deficit of this element could alter the most important regulatory system. The effect of these alterations could, in some cases, even cause death from dehydration.

The need for water is extremely high at any age, especially at paediatric age.

ATTUALITÀ IN TEMA DI NUTRIZIONE

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## THE CLASSIFICATION OF THE WATER WE DRINK

Water assumed to satisfy our biological needs, especially thirst, could be generally subdivided into three categories:

- 1) potable water: it should be a natural water with a dry residue (DR) at 180°C approximately 500 mg/L (medium mineral), limpid, inodorous, colourless, palatable; in reality in the practice water is delivered with tensioactive (admitted until 0.5 mg/l dosage in potable water), chloride, traces of other contaminants, according the limit restricted by law;
- 2) table water: law permits to only commercialise water not containing minerals noxious to our health (lead, selenium, arsenic);
- 3) dietetic water: they're particular mineral water capable of having dietetic properties (breastfeeding, sport) either for physiologic status either for morbid status (colitis, hypertension, dyspepsia).

Water in last two categories constitutes the so-called natural mineral water that could be commercialised as well as they're delivered from the source or added with carbonic dioxide.

Determination of the Dry Residue (DR) to 180°C consent as by ministerial decree 01/02/1983 "New regulations for mineral water's label", considering CEE's directive, to classify mineral water in:

- 1) Water minimum mineralised with DR at 520 mg/l;
- 2) Water low in mineral content or slightly mineralised with DR between 50 and 500 mg/l;
- 3) Water enriched with salts minerals with DR more than 1500 mg/l.

The lawgiver didn't take into account water with DR between 501 and 1500 mg/l. In practice, this category constitutes medium-mineral water group.

This new classification entered in force in 1983 and reconfirmed by the application of the decree law 105, modified mineralization limits, abolishing the category of medium mineral of the old classifications Marotta and Sica (1929), here reported:

- 1) Water low in mineral content with DR, equal or inferior 200 mg/l at 180°C;
- 2) Medium-mineral water with DR between 200 mg and 1 gr/l at 180°C;
- 3) Mineral water with DR higher than 1gr/l at 180°C.

On the ground of saline composition, water is perhaps classified:

- 1) **Bicarbonate Water**, when the contents of bicarbonate are higher than 600 mg/l. All the water with the anion  $\text{HCO}_3^-$  percentually predominant is thus classified. Calcium carbonate is a prevalent element (48,7%); if it's drunk during meals, it aids digestion accelerating gastric emptying, yet if drunk during fasting it plugs gastric acidity. Doubtless is the positive action of the bicarbonate in the liver insufficiency and on spastic dyskinetic phenomenon of the biliary way. Bicarbonate water is indicated even for sportive activity in so far as bicarbonate and calcium are able to neutralize muscular metabolism's residuals (lactic acid). Good is their employ for gastric dyspepsia at infancy's beginning (usual vomiting in the breastfed) and as a food integrator during weaning and the following period, because it furnishes numerous mineral elements. They've a good diuretic action (correlated to dry residue's values) and in-

duce a spasmolytic effect that could be efficacious in the chronic cystitis.

- 2) **Sulphate Water**, when sulphate's contents are higher than 200 mg/l.

On the market, sulphate-calcium's water represents the 5,20%, the sulphate-sodium's the 4,49% and sulphate-magnesium the 0,72% of the whole. They're lightly laxative and then they're indicated in the individuals with spastic colitis alternating constipation and diarrhoea. They exert a relaxing effect on the biliary musculature in order to be efficacious in the hepatic and biliary dysfunction.

- 3) **Chloride Water**, when chloride's contents are higher than 200 mg/l.

From the chemical point of view, in this water there's a prevalence of chloride anion (by law it should be higher than 200 mg/l) and sodium as cation. Chloride-Sodium water are represented by Montecatini's water and they've a balanced action on the intestine, on the biliary and hepatic system. Furthermore Montecatini's water, besides its spasmolytic and choleric action, defends hepatic cells from toxic agents through enzymatic system's induction. It's important to remember the typical purgative and laxative action of sulphate water, perhaps with the necessity of longer treatment.

- 4) **Magnesium Water**, when magnesium's contents is higher than 50 mg/l.

Bicarbonate', sulphate', chloride' and magnesium's water mainly carry out a purgative action, but they find indications in arteriosclerosis' prevention because, as in the ones containing lithium and potassium, induce a sensible arterial dilatation. Deficiency in magnesium could be characterized by abdominal cramps, headache, anxiety, fatigue, dizziness and dyspnoea.

According to recent studies, the evidence as shown that magnesium represents a therapeutic and preventive support in obstetrical and gynaecological pathologies, particularly in premenstrual syndrome, during pregnancy, climacteric syndrome and in the post-menopausal osteoporosis.

- 5) **Fluorate Water**, when fluor's contents are higher than 1 mg/l.

This water is ideal for the prevention of cavities in children under 14 years. However, an excess in fluorine could bring this element to an accumulation in the teeth and gums, so we suggest a non-continuative usage of this water. Even pregnant women should drink fluorate water, since the first dental stamp will be formed already in the foetus.

- 6) **Calcic Water**, when calcium's contents are higher than 150 mg/l.

They're found as bicarbonate-calcic water. Their actions are at gastric and hepatic level. According to an American study, it became evident that the daily assumption of 800 mg calcium is able to reduce the risk of hypertension and favouring the achievement and maintenance of a correct osseous density.

- 7) **Ferruginous**, when ferrous' contents are higher than 1 mg/l.

It's indicated as an integrator in medical therapies in the individuals affected by anaemia with an iron deficiency; intestinal absorption is under the form as ferrous ion. It's advised against individuals affected by gastroduodenitis.

- 8) **Sodic**, when sodium's contents are higher than 200 ms/l.

This ion has an important biological function because it influences positively neuromuscular excitability. A sodic water is contraindicated in individuals with hypertension.

Particularly important is nitrate's contents in mineral water: pollution by nitrates is constantly increasing. Nitrates are the last phase of the azotes oxidation process (azotes → ammoniac → nitrites → nitrates), constitute a pollution index that could be either of organic nature due to animals dejections coming mainly from swine-breeding, either inorganic coming from industries (acid rainfalls rich in azotes) but especially from azotised fertilizers employed in agriculture.

The limit fixed by the World Health Organisation (WHO) and from CEE's policy is 50 mg/l. Nitrates introduced in the organism are reduced to nitrites and, in the contact with the amines, form the nitro-ammines, suspected to be carcinogenic. Therefore, it's important to give the preference to water with a low level of nitrate, especially if the product is designated for women and children.

## WATER IN INFANCY

In infancy, daily water intake is highly elevated as it represents 70-80% of body weight. For this reason, to assure an adequate water and mineral supply, water consumption should be high from the first months of life and increase rapidly according to baby's age. The need of security for food in children's nourishment is one of the reasons that influences the parents' choice. Recently, it's been observed that there is a constant increase in mineral water utilization.

The motivation of this phenomenon is connected to a double order of factors:

- The growing disaffection against potable water to the progressively organoleptic decay, linked to principally to potification;
- Episodes of pollution or contamination in aqueduct water.

Mineral water gives a real security in practice and employ, connected to a constant composi-

tion as indicated by the labels at periodical controls. Finally, preparing water kits according to the hygienic rules guarantees a perfect conservation of the fundamental physical-chemical characteristics and organoleptics. The absence of microbiological contamination permits without any previous boiling which leads water to lose its gas dissolved and plunge some salts.

It's undoubtedly demonstrated that mineral water in children's diet or in the reconstitution of milk formula, or in the dilution of cow milk or as daily drink or, finally, as "co-adjuvant" in the dietetic therapy in dysmetabolic condition characterized by liquid lost and alterations in acid-base balance.

Although, still today, mineral water is frequently suggested by doctors in a too generic way based more upon advertisements than the intrinsic quality coming from chemical and physical composition.

In consequence, it's fundamental to know how to classify their principal characteristics and, consequently, to suggest the use in different physiological or pathological conditions of the child.

**Water slightly mineralised and water low in mineral content** are characterized essentially by a diuretic action and they favour urinary elimination of azotes, chloride, magnesium and phosphorus. They're indicated during urinary tract infections, in lithiasis, diathesis, ketoacidosis and toxicosis.

In paediatric age they find indications in milk formulas' reconstitutions and cow milk's dilution. Thanks to their ipotonicity, they could exert a notable solvent action, improving lipids' dispersion contained in milk. Moreover, they determine a inferior osmolarity in milk mixture and then an inferior renal charge of solutes.

Water slightly mineralised and water low in mineral content have a buffer capability significant-

ly inferior to water precedently classified as medium mineral and, consequently, need an inferior secretory commitment by the stomach, that has the necessity to reach an optimal pH in order to carry out an adequate peptic activity.

**Water** actually defined as **medium mineral**, with DR between 501 and 1500 mg/l at 180°C, has intermediate characteristics between soft water and those mineralised, being more similar to the former when they've a DR adequately limited, to the latter when they've a considerable content of minerals; however, we should remember that mineral water of the actual legislation don't find indication for hypotonic, especially at infancy.

Among medium mineral water most recommended in feeding children is the bicarbonates-alkaline-earthy. This water for its good mineralization, especially rich in calcium, could indeed be useful in periods of intense growth, such as evolutive age, as valid contribution to the achievement of an adequate calcium intake. Numerous clinical studies have evidenced an insufficient intake in calcium in the paediatric population, especially in females. Calcium assumption in adequate quantity is so recommended for achievement of a peak of osseous tissue that is expression of genetical individual capability. For that reason it's particularly advisable to consume bicarbonate calcic water. It significantly contributes to the daily intake of calcium in ionic form easily and naturally absorbable. This occurs without excessively medicalising the individual.

Medium mineral water is even suggested in paediatric age for several reasons:

- It contains an optimal quantity of calcium able to guarantee the rapidity of caseinic coagulation process and clot fines and well dispersed;

- It maintains a diuretic activity;
- In case of ketoacidosis or toxicosis, it favours rapid elimination of toxic catabolites and exerts a buffer action and a rapid restoration of the well called alkaline reserve.

Moreover, medium mineral water has high buffer capability bound to remarkable carbon acid (not to be confused with carbon dioxide in sparkling water) nearly always present. This water has its principal action at gastric level, as a buffering one. It could then be revealed useful in the hyperchloremic dyspepsia: in this case, if taken during fasting, it neutralizes hyperchloremia and it passes rapidly in the duodenum where they inhibit gastric secretion.

In paediatric practice, elective use of this water is in ketoacidosis status consequently to febrile disorder or dysmetabolic situations in so far as, due to its high content in bicarbonate, it carries out a relatively buffering action and, if taken for a sufficiently long period, it tends to restore an alkaline reserve.

The validity in utilisation of the medium mineral water during infancy, especially bicarbonate-alkaline-earthy water, is confirmed even during enteritis of slight or medium severity, when a ready and correct regulation of acid-base balance and of the thermoelectric one represent the first and fundamental therapeutic intervention to restore child's health status. The utilisation of medium mineral water is also suggested in all the conditions as intense sweating with a consequent liquid loss, as in sports. In these situations an adequate liquid supply should be recommended before physical activity, in order to avoid dehydration that occurs more rapidly in children than in adults.

It's also highly demonstrated through literature that water bicarbonate-calcic exerts a buffer effect upon lactic acid produced by muscles

during exercise, contributing significantly to enhance the threshold of resistance to fatigue and in accelerating the phase of recovery post-strain.

**Water rich in salt minerals**, due to its high saline content (DR more than 1.5 g/l), isn't useful in feeding children.

It's rarely employed as a refreshment in particular pathological condition in adults and its employ is really exclusive in thermal therapy.

The utilisation of some minerals (sodium and chloride) presented in water could supply to the organism a higher content than recommended, while, through the utilisation of water low in mineral content, we don't reach daily requirements of calcium.

In this panorama a water classified as medium mineral is the exception but with sodium contents inferior to the recommended requirements by WHO for paediatric feeding (20 mg/l).

Oligoelements supplies (particularly iron, zinc and copper) in mineral water is really scant and generally is not connected to DR at 180°C. It's useful to remember that in case a mineral water should be suggested for paediatric utilisation, the importance of the contents of some substances such as fluoride, iodine and nitrates.

**Fluoride.** its protective effect on the cavities is well documented and its optimal dosage is 1-1.5 mg/die. The provision of fluoride distributed in bottled water is undoubtedly the best alternative to fluoridation of potable water. The fluoride-prophylaxis through mineral water presents some advantages such as the strict control of the quantity of fluoride, without risking an excess that could lead to fluorosis. It is a non-coercive method that allows every citizen to freely defend his health.

**Iodine.** Concerning iodine, it would be useful to deliver mineral water addicted with an optimal content in iodine in some endemic areas of goitre, considering that every child's daily need is 20-100 µg. Iodine low level in water is considered the main cause of goitre in the endemic area.

In Italy, a limit for nitrates up to 50 mg/l has been established. However, this limit refers to adults and then, in consideration of the extreme sensibility of the youngest children to induction of methemoglobinemia by the nitrates. In water used for the breast-fed's diet, the levels of nitrates shouldn't pass the 10 mg/l.

The parents' choice concerning mineral water is influenced by paediatricians (40%), while just 5% of parents decide as a result of advertisement campaigns.

For this reason, paediatricians and caregivers must necessarily possess a deep scientific knowledge of the chemical and physical characteristics of the various mineral waters. This knowledge obtained, within a nutritional cultural field, must be rationally employed in physiological condition either co-adjuvant in many pathological situations (febrile status, dyspeptic syndrome, gastroenteritis, etc.), where it's necessary to have a correct maintenance of hydroelectric and acid-base balance.

## WATER IN THE SPORTSMAN

The quantity of liquids required during a specific activity is strictly bound to the typology of sports, to resistance or power and to climatic condition during training or sportive competition. After dehydration, or body water loss principally caused by a sweating process during physical exercise, a rapid re-hydration based on the assumption of liquids should immediately follow. In addition to restoring hydrosaline

balance, it removes the manifestation of fatigue, favouring elimination of the heat produced. A liquid loss slightly inferior to 2% of body weight, inexorably influence sportive performance. It's appropriate to know that the mere presence of thirst stimuli is a sign of hypo-hydration. For this reason in sports of resistance such as running, bicycling and marathon racing, It is suitable to frequently drink small quantities at periodic intervals, anticipating the thirst.

At rest, a person normally consumes on average 1.5-2.5 litre of water per day.

During training, a daily supplementation of 1.5 litre is advisable. It is even better if bicarbonate-alkaline-earthly water is consumed at refractory doses starting 1-2 hours before physical activity, later at more or less regular intervals during physical activity itself.

After the strain, it's advisable to introduce a quantity of liquids equal to the body weight lost during training. In the competition day, it should to drink a good quantity of mineral water at ambient temperature, in small quantities.

At least two hours before competition, in order to create favourable conditions to eliminate toxic metabolites produced by the physical strain, it's suitable to start the consumption in small quantities and ambient temperature of 500-700 ml of water, with dry residue at least 550 mg/l, a ionic prevalence bicarbonate-alkaline- earthly addicted by 35 g of glycerine that is able to keep for a longer period water inside the organism. The day after the competition, liquid assumption strives to eliminate azote residuals, correcting the acidosis produced by muscular fatigue.

## **WATER IN THE ELDERLY**

In advanced age, water constitutes only 53-46% of the organism. The elderly has sense of

thirst, that it induces to suggest to drink copiousness natural low in mineral content water with low dry residue, alternating it with water with dry residue at 300-500 mg/l in order that the prevailing assumption in water with low dry residue permits a right hydration without any excessively engagement of renal excretory function.

## **CONTAINERS AND MATERIALS EMPLOYED**

Mineral water bricks are of three types: glass, plastic (essentially PET in so far as bottles in PVC, until some years ago highly diffused, actually unemployed) and poly laminate packaging or polythene coated card (brick). From 1985 to today, amount in glass container has diminished from 92% to 42% while those in plastic augmented from 6,5% to 55% and those in coated card from 1,5 to 3%. The main connected to lower cost of transport.

### **POLYTHENE COATED CARD (BRICK)**

Polythene coated card is multi-layered, where the paper is represented in 80% (Tetra brick Aseptic), to which it's linked together with a slight layer of pure polyethylene (15-20%) and a sheet of aluminium (3-5%). The base element is the paper, wich gives form and rigidity to the container; paper comes from replanted forests that represents a renewable resource in nature.

The polyethylene is used to make the container impermeable to the outer agent permitting the union of various materials without any glue or adhesives. The polyethylene belongs to the family of molecules correlated to methane, whose notable characteristics include a clean combustion and non-toxicity. The interposed aluminium to the multiplayer protects water

from alteration that could come from the light and air, permitting a conservation of all the original organoleptic characteristics. The advantages of the polyethylene are cancelled by only one apparently insignificant defect, the transparency. The inability to see the content has limited its commercialisation to 3% of the total production of mineral water.

#### POLIETILENETEREFTALATO (PET)

The PET purposes to be an alternative material to glass, being that it is perfectly transparent, light, resistant to impact and could assume different colouring, in protection of the liquid it contains. The PET is a plastic material relatively young and its usage on a large scale in the mineral water field has begun in the past 4-5 years. The PET could be recycled in a different way. The most simple and correctly employed is the fusion of clean flakes and their threading to obtain fibres of polyester for tissues. Moreover, PET conserves an important content of petrol energy from which is obtained and could be burned as an alternative combustible to con-

vert its energetic content into another energy, as electricity or heat. Many industries are activating in PET bottles' recycles in Europe.

#### GLASS

Glass is obtained by fusion, at temperatures of at least 1200°C in a basin oven covered by special refractory materials, of sands siliceous with sodium and calcium carbonate that are then transformed at first in oxides and afterward, through fusion and cooling, in a viscous liquid. In this containers are obtained through two systems: blown-blown or pressure-blown. Some researchers have formulated the hypothesis that glass, not for a fault of its own, as a result of the excessive utilisation by its producers, transfers inorganic substances such as silicates into water. However it's a false problem because this transfer always stays far below the limits fixed by legislation. Moreover, it is improbable that a bottle is used more than twenty times during its life, due to the fact it could be refused by the electronic control system, as a results of slippage along the wall guide of carrier tape, causing frosting of the glass.

## CONCLUSION

To conclude, in the following table we've resumed elements in favour or against of mineral or potable water:

### **NO TO THE COMMON DOMESTIC POTABLE WATER, BECAUSE:**

- 1) **Source of supply** prevalent (80%) but not totally guaranteed by subterranean water; their progressive depletion impose the adoption of an integrated system such as the supply from superficial water.
- 2) **Frequents and different possibilities of contamination:**
  - a – from the resources, such as source of supply either subterranean either superficial by fertilizers, pesticides, nitrates and heavy metals;
  - b – from process of potification: the use of chloride or sodium hypochlorite, in phase of precursors constitutes by organic substances (uric acid), brings to the formation of halogen compounds (trihalomethane) involved in intestinal tumour's pathogenesis; today's use of chloride dioxide results more secure;
  - c – in the distribution net: different mechanisms are bound to materials of pipes, to their maintenance status, to the modality of management, to water's chemical characteristics, etc.; the main problem seems to be linked to corrosion and, consequently, to transfer some substances employed for construction or the pipe-cover (cement, amianthus, copper, zinc steel, lead).
- 3) **Quantitative of nitrates not proposable for the breastfed.**
- 4) **Difficulty for the consumer to control organoleptic characteristics.**

## WHY YES TO MINERAL WATER

- 1) **Usually Spring Source of supply**
- 2) **Packaging that guarantee the sterility and the conservation of the chemical-physical characteristics**
- 3) **Constant composition**
- 4) **Variety that permits to operate a choice in function of the different needs.**
- 5) **The use of mineral water moderately fluorated consent to realise an efficacious fluoride-prophylaxis, thanks to their constant fluoride content easy to be found and used**

## FINAL RECOMMENDATIONS

In particular we recommend the consumer to pay attention to five fundamental rules that permit to make a wise choice:

- 1) to learn how to carefully read water-labels, favouring water low in mineral content and medium mineral water as for table drinks;
- 2) to avoid excessive carbon dioxide additives in water, that are more refreshing but cause more acidity;
- 3) to read carefully the following values:
  - dry residue, nitrates, sodium, fluoride and sulphates: high contents of these substances may have some contraindications;
- 4) to control container's integrity and its expiring date; although water in a plastic container is non-perishable, it should be drunk within 5-6 months, while water in glass containers consumed within a year;
- 5) attention to the price, it's not definite that higher-priced water is the best, in terms of nutritional content.

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