Innovative Postgraduate Education in The Field of Environment Protection: Methods and Tools

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Food Science and Nutrition: new prospective for human and environmental health

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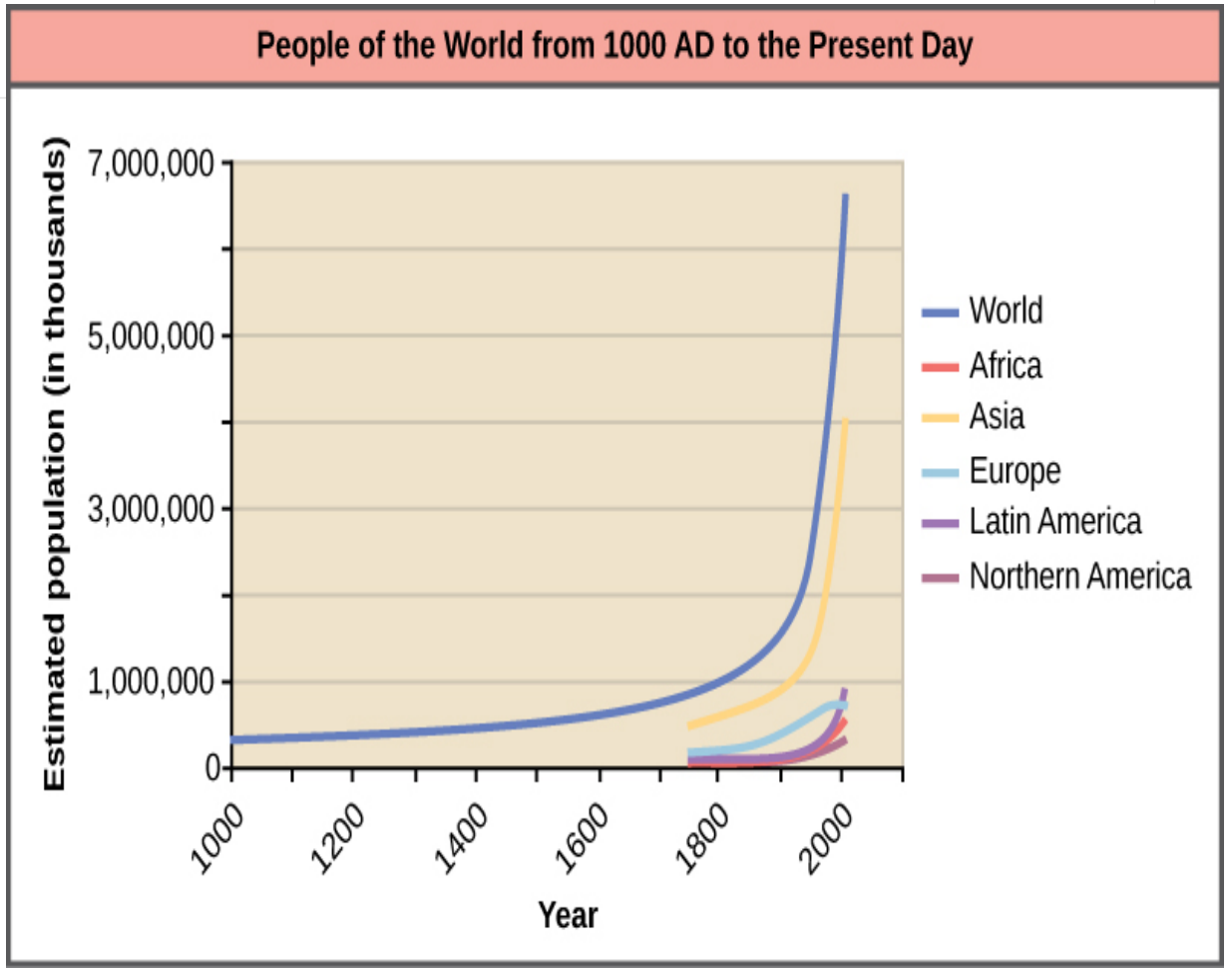
The world's human population is exponential growth

- The world's human population is currently experiencing exponential growth even though human reproduction is far below its biotic potential (Figure 1). Also, resources would have to be such that the environment would support such growth. Neither of these two conditions exists. In spite of this fact, human population is still growing exponentially.



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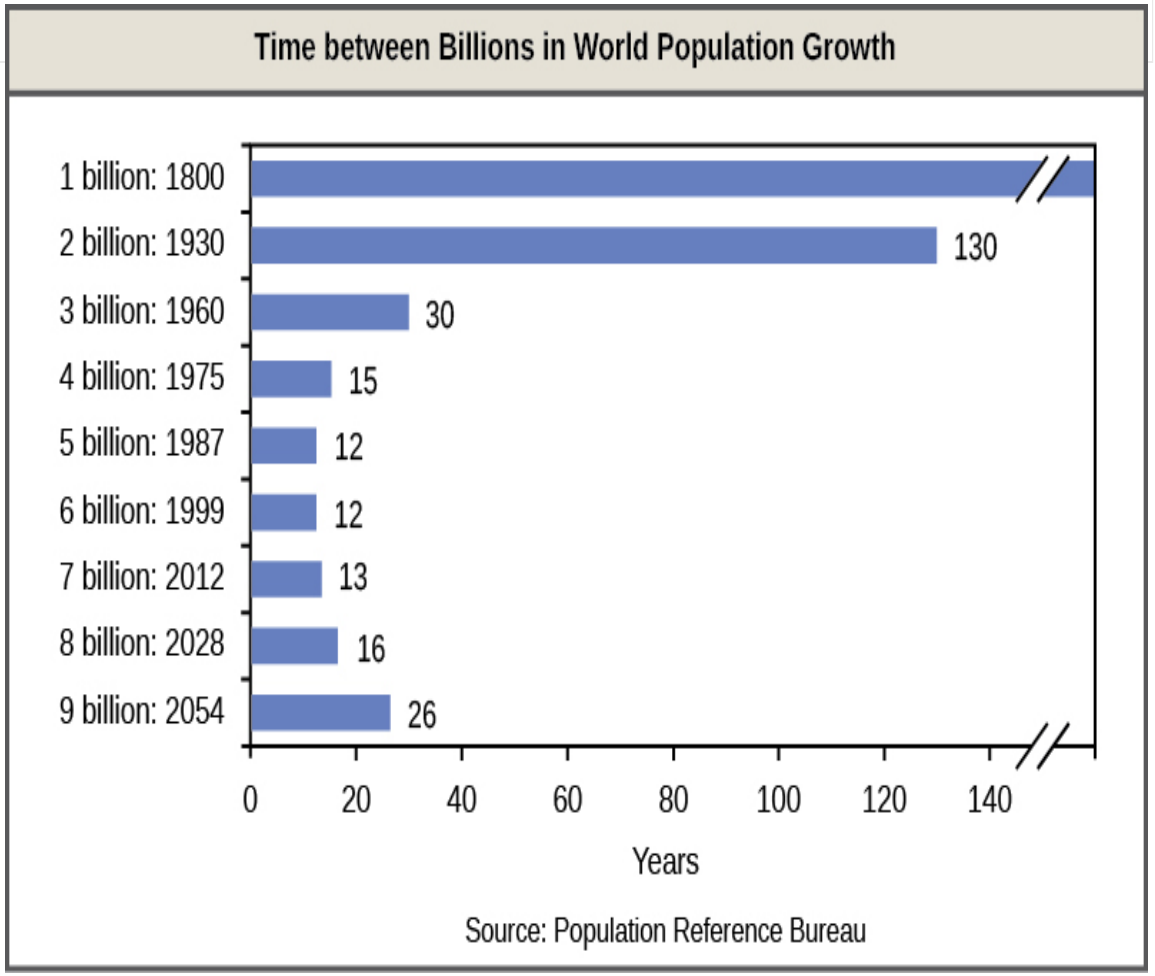
- A consequence of exponential human population growth is the time that it takes to add a particular number of humans to the Earth is becoming shorter.

- And the availability of food becomes fundamental.



Human nutrition is a science that is constantly evolving

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- A study published in 2010 by the European Union had highlighted the fact that every year the manufacturing industry discards almost 90 million tons of food waste (European Commission, Food Waste across EU 27, 2010).
- These numbers include the raw materials discarded by the agri-food industries due to problems of process, palatability or acceptance by the consumer (eg peel, seeds, films).
- In practice, almost a third of the food produced worldwide is lost or wasted along the entire food chain, from the agricultural production phase to domestic consumption, generating avoidable economic, environmental and social impacts and therefore representing one of the biggest problems for development. sustainable development of our planet.
- These are not only a loss from a commercial point of view but also a cost for disposal.

Tons of agricultural production left in the fields (2009) - SOURCE : BCFN – FAO, CREA

	PRODUZIONE TOTALE (000 t)	PRODUZIONE RACCOLTA (000 t)	RESIDUO IN CAMPO (000 t)	%
 Frutta	62.178	61.069	1.108	1,78%
 Agrumi	37.849	37.095	753	1,99%
 Olive*	34.541	32.866	1.675	4,85%
 Uva**	83.131	80.378	2.752	3,31%

The commercial chain of fresh summer fruit sees large quantities of product discarded daily wasted due to calibration or aesthetic defects.

In small rural businesses that do not have storage facilities, significant waste is generated in the seasonal peak of production, when the market is not adequately receptive.

The waste is a very important issue in production areas with small farms, not very structured from the logistical point of view.

In Italy, this problem is very evident, given the lack of an associative culture by virtue of the presence of a very important market, such as that of the city of Rome, which has given the possibility even to small producers to market their production directly in the local markets.

Or through general markets for distribution to other resellers.

SPECIES	non-controlled environment Days	controlled environment Days
Peaches / nectarines	4 – 5 (b)	8 – 15 (b)
Cherries	1 – 2 (b)	4 – 5 (b)
Apricots	2 – 3 (b)	6 – 7 (a)
Plums	2 – 3 (b)	6 – 7 (a)
Strawberries	1 (b)	2 – 3 (a)
Figs	1 – 2 (b)	2 – 3 (b)
Apple	15 (b)	>1 month (a)
Pears	5 – 6 (b)	7 – 10 (a)

Days of fruit conservation in a controlled and non-controlled environment; SOURCES:(a) EnteCRA 2011;

Dehydration

- **ONE OF THE OLDEST METHODS OF FOOD PRESERVATION;**
- **OBJECTIVE: TO REDUCE MOST OF THE H_2O OF A FOOD BY APPLYING A HEAT FLOW UNDER CONTROLLED CONDITIONS.**

PROS

- Inhibition of growth and reproduction of microorganisms
- Reduction of enzymatic activity
- Reduction of weight, volume and dimensions of the product

→ Increased shelf-life

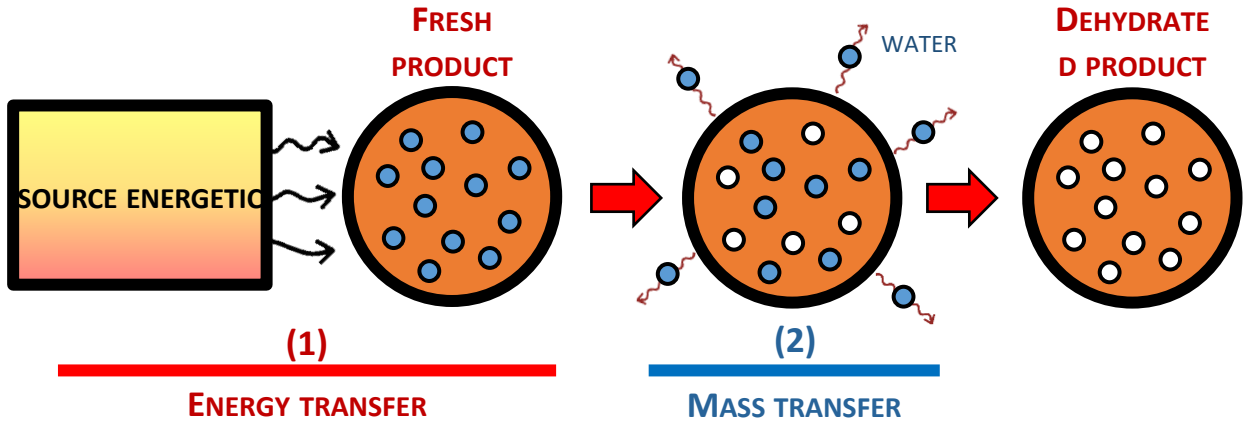
→ Reduction of packaging costs;
Ease of transport and storage;

CONS

- Shape variation (shrinkage)
- Change in color (browning)
- Change in flavor (flavor)
- Texture variation
- Variation of nutritional and functional properties

→ Reduction of consumer acceptance

Mode of dehydration



Evaporation
- Hot-air drying (hot air dehydration)
- Spray drying (liquid or semi-liquid foods)

Sublimation
- lyophilization

Hot-air drying

PROS

- More conventional dehydration method and mostly used in the industrial field
- Simplicity of operation
- High dehydration efficiency
- Rapid
- Economic
- High production capacity

CONS

- Method that induces the highest degree of degradation of the product due to long exposure to high T
- Drastic variation in the shape of the product
- Drastic reduction in volume
- Color variation
- Loss of flavor
- Loss of thermolabile nutritional compounds (eg vitamins, phenolic compounds, carotenoids

Spray drying

SPRAY DRYER INDUSTRIAL

NANO SPAY DRYER (LABORATORY-SCALE)

PROS

- Inexpensive, relatively simple and fast process
- The product is exposed to the high T only for a short period of time → Better preservation of nutrients (especially the thermolabile ones) and aromas compared to hot-air drying
- High rehydration capacity of the product
- Greater production capacity compared to freeze drying
- Possibility of association with other downstream instruments (eg encapsulators) → High versatility

CONS

- Suitable for liquid products only → Pre-treatment necessary to convert the product into liquid or pulp form
- Use of high T (> 80 ° C) which can cause alterations of the organoleptic characteristics and loss of the most thermolabile substances
- Very large industrial instrumentation dimensions
- Greasy matrices may require special preparation to remove excessive levels of grease that could damage parts of the equipment

Liofilizzazione

INDUSTRIAL LYOPHILIZER

LABORATORY LYOPHILIZER

PROS

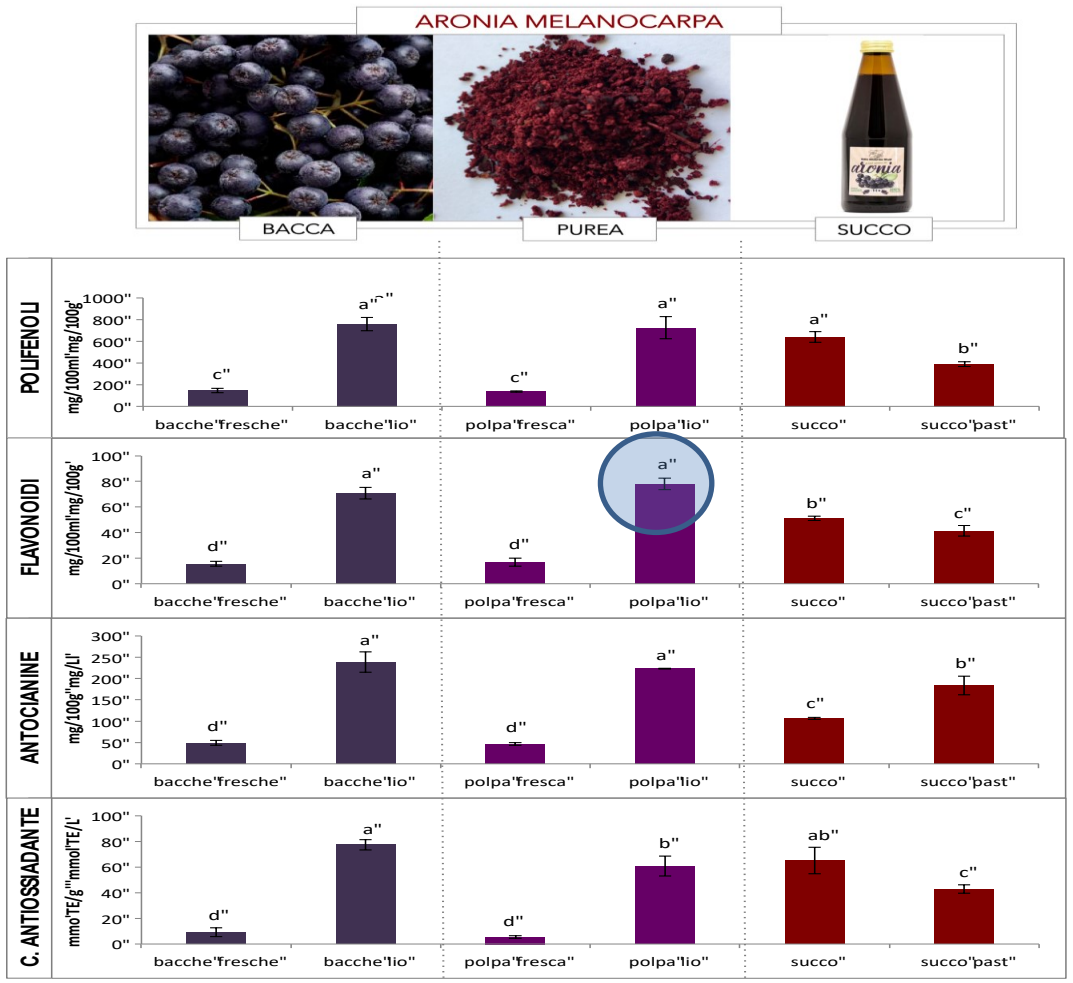
- Best method to preserve the original characteristics of the product (color, flavor, shape, size) → particularly suitable for producing high quality dehydrated products containing thermolabile compounds (e.g. vitamins)
- High rehydration capacity of the product
- Quick and easy pre-treatment of the product to be dehydrated (freezing)

CONS

- Suitable for liquid products only → Pre-treatment necessary to convert the product into liquid or pulp form;
- Use of high T (> 80 ° C) which can cause alterations of the organoleptic characteristics and loss of the most thermolabile substances;
- Very large industrial instrumentation dimensions;
- Greasy matrices may require special preparation to remove excessive levels of grease that could damage parts of the equipment;

Order of methods in terms of quality and cost: Lyophilization> Spray drying> Hot-air drying

Recovery of fruit processing waste.



Fruit juices and pulp (puree) as a waste product from pressing.

- Recently it is emerging that both black grapes, blueberries and plants such as Aronia are particularly rich in polyphenols and in particular among flavonoids, procyanidins, phenolic acids and anthocyanins, they are among the very promising molecules in this sense. .
- For this reason, at the Cellular and Molecular Nutrition laboratory it was decided to carry out some analyzes to enhance the Aronia juice.
- The results showed that aronia juice has a high antioxidant power (more than 40 millimoles TE / liter) and high levels of polyphenols (more than 400 mg / on 100ml), flavonoids (more than 40 mg / 100ml) and in particular of anthocyanins (more than 150 mg on 100g).
- However, the pulp also called puree, that is the waste product of the pressing is even richer in polyphenols and antioxidant power than the juice.

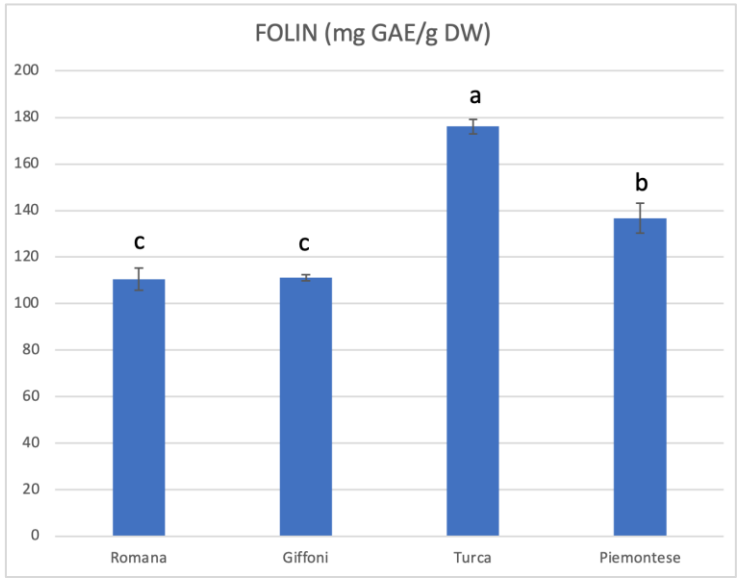
Nutritional value of Hazelnut skin

- Considering the large production of hazelnuts in the province of Viterbo and the possibility of establishing interactions with local processing companies, the hazelnut skin was considered as the first waste matrix. The hazelnut skin is a fibrous layer present between the fruit and the shell, which for aesthetic and palatability reasons is separated from the fruit and discarded following toasting. The hazelnut film is currently handled as a waste material, and therefore either disposed of or thrown into the fields as fertilizer.

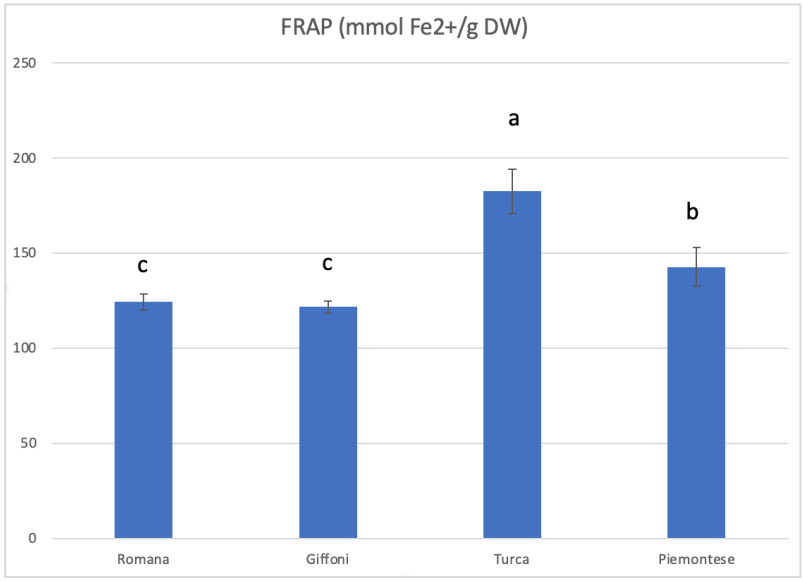
Figura 4. Nocciola intera con guscio, frutto con pellicola e frutto senza pellicola. A destra pellicole separate dal frutto.

Antioxidant power of the nuts skin

METHOD FOLIN



METHOD FRAP



Biscuits with hazelnut skin

PERCENTAGES OF INGREDIENTS ADDED FOR EACH TYPE OF COOKIE (CTRL CONTROL COOKIE) HSC (HAZELNUT SKIN COOKIE)

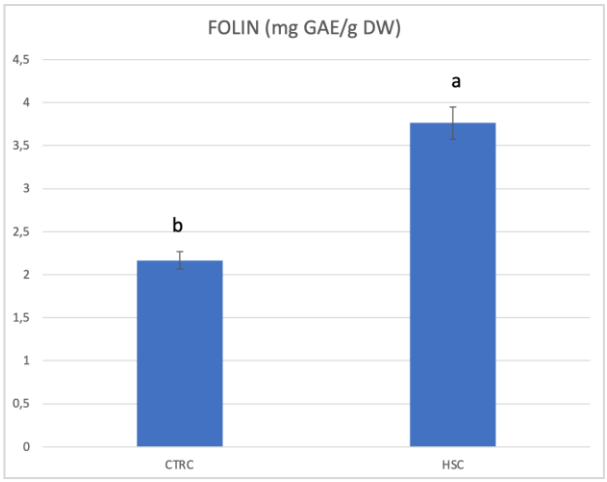
	CTRC	HSC
Farina 00	47,4%	40%
Pellicola Romana	-	10%
Burro	20,2%	18%
Zucchero	19,1%	19%
Uovo	11,6%	11,6%
Vaniglia	0,6%	0,6%
Lievito	0,8%	0,8%

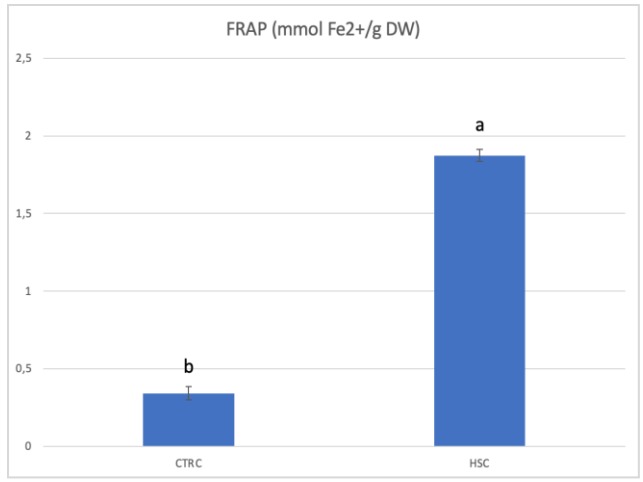
LEFT CTRL (CONTROL COOKIE) RIGHT HSC (HAZELNUT SKIN COOKIE)

progettato HSC.

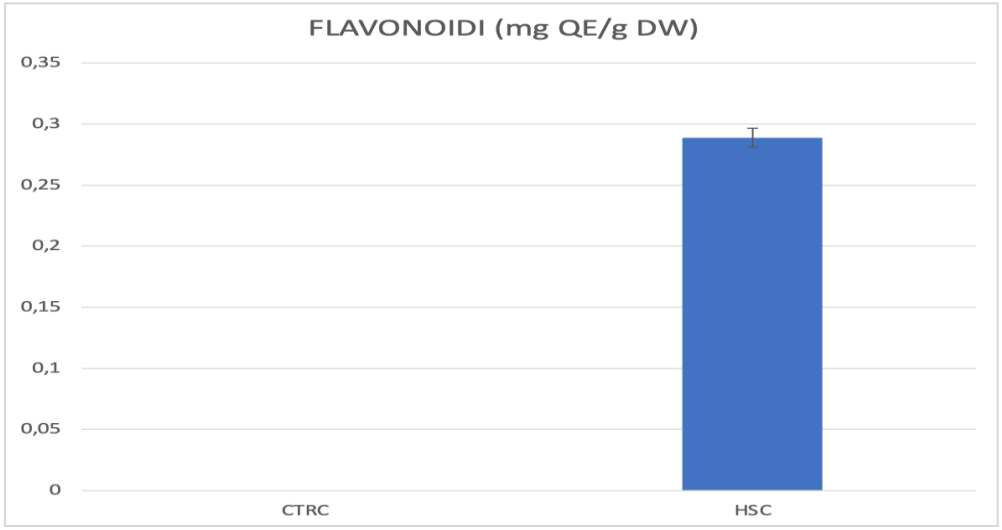
Antioxidant level

NUTRITIONAL VALUES BISCUITS WITH HAZELNUT SKIN

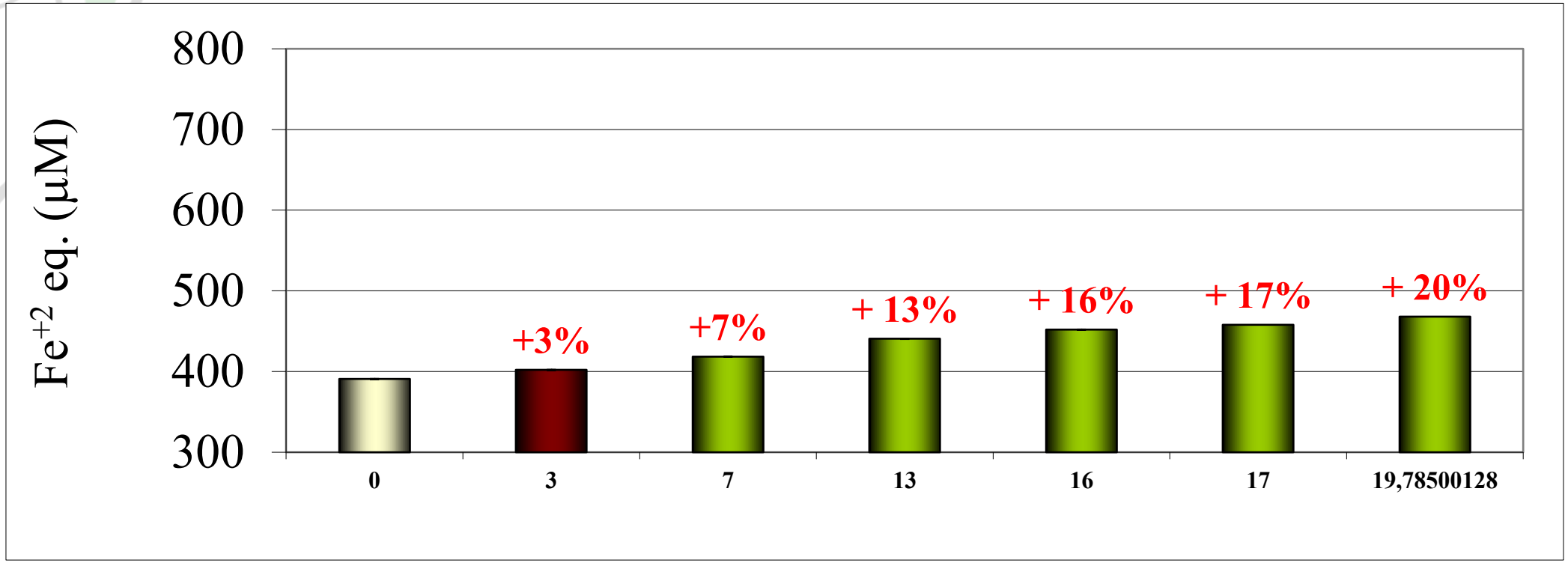




	Umidità	Proteine	Grassi	Carboidrati	Ceneri	kcal/100 g	kJ/100 g
CTRC	4.79 ± 0.06^{B}	7.86 ± 0.06^{A}	20.50 ± 0.20^{A}	70.50	1.14 ± 0.02^{B}	474,11	1983,69
HSC	5.71 ± 0.04^{A}	7.34 ± 0.23^{A}	21.31 ± 0.46^{A}	69.97	1.39 ± 0.01^{A}	472,40	1976,54



coffe tq; coffe+estr 180; caffe+estr 270; coffe+estr 360;



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Thank you for your kind attention!