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Shaping future agriculture in salt affected and arid lands

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Session 7: Best cropping practices to cope with abiotic stress

Session chair: Irfan Afzal, *UM6P, Morocco*

Keynote speech:

Quinoa Biodiversity, Agricultural Practices, and Nutritional Profile Variability Under Stress Conditions

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Biodiversity conservation is at the heart of the international community's global concerns with the last IPBES, IPCC or FAO reports. This loss of biodiversity jeopardizes our agriculture and our food. Quinoa cultivation evolved from a complex process of biological, geographical, climatic, social and cultural interactions that determined its current high genetic diversity.

The main question is: What are the New Pathways for a Nutrition-Sensitive Agriculture?

QUINOA is *a small quality grain with a diversity of uses.*

We can develop a on exhaustive list of PRODUCTS OBTAINED BY THE TRANSFORMATION OF QUINOA:
Whole, Expanded, roasted, pre-cooked grains, ...
Flour, Pre-cooked flour: Breads, cookies, cakes, cakes.
Milk
Flakes
Extruded
Starches
Dyes: Betalains, Beezzhanthins.
Saponin, biocides, repellents.
Concentrated protein
Pearl
Sprouts, freeze-dried leaves, pickled panicles.
Grained: Quinuoto
Malts and nectars
Noodle and pasta making
Sweets, jams, liquors, beer, etc.

Focusing on the two objectives of the IYQ in 2013: Genetic Diversity and High Nutritional Value. The assumption was that small farmers maintain the genetic diversity of quinoas, which provides us with a grain with a very high nutritional value, a superfood!

The Plurinational State of Bolivia has requested FAO to declare 2013 the International Year of Quinoa.
By resolution 66/221 of 22 December 2011, the United Nations General Assembly proclaimed 2013 as the International Year of Quinoa (IYQ) and the secretariat was assigned to FAO-RLC (Santiago de Chile). The

objective of the IYQ was to draw the world's attention to the role of biodiversity and the nutritional value of quinoa in food security & poverty eradication, in order to achieve the Millennium Development Goals.

Over the past thirty years, quinoa has been tested on every continent and today, quinoa is grown in more than 125 countries. The globalization of quinoa poses challenges for countries of origin and it is important to take this into account for future development. Understanding this reality is essential to address the challenges of conserving local biodiversity, developing and promoting new varieties, and cooperating in the exchange of plant genetic resources with inclusive processes towards equitable benefits with Andean countries.

Who are the new quinoa producers?

Small scale farmers with <2ha for diversifying their cropping system (>90%)
Less than 25% with irrigation
Organic production (Andes) and more conventional production abroad
Commercial varieties selected for high grain yields!

=> Not necessarily a nutrition-sensitive agriculture

Andean peasant varieties of quinoa are heterogeneous and well adapted to extreme climatic and soil conditions thanks to a very high intra-varietal genetic diversity => Dynamic complex system (variety populations) that contributes to the stability of the production and the resilience of its nutritional profile.

Outside the Andes: Only 1 to 3 regular commercial varieties by country. Only a very small part of the available genetic diversity is used for the adaptation of quinoa to new environments and for nutritional value. Always the same commercial varieties are widely distributed.

The balanced structure of essential amino acids is one of the main characteristics of quinoa, but not the only one. Quinoa grains contain a very high proportion of mono- and polyunsaturated fatty acids (especially omega 3,6,9) = essential for human growth and development (brain, muscles, retina).
Very high levels of vitamin E or tocopherols as potent antioxidants (α, β, γ and δ) and tocotrienols (α, β, γ and δ) with known biological activity, essential for the reproduction and growth of mammals, including humans.
α-tocopherol in particular is a powerful antioxidant that prevents the oxidation of plant lipids, especially seeds. (to fight against cholesterol). Protects the body from cell damage = > maintains a healthy immune system to protect against chronic diseases, such as heart disease and cancer.
Quinoa is also very rich in many minerals,
And it contains a lot of fiber useful for moderating the glycemic index of foods.
Vitamin B1 allows the production of energy from carbohydrates (sugars). Vitamin B9 or folic acid (also known as folate) is essential for cell renewal and fetal development during pregnancy.

BUT WE NOTE a strong variability in the average composition of quinoa grains! That generate a big GAP for the future of Quinoa food products.

Quinoa is a healthy product, between belief and representation: i/ A product grown by hand in a natural way on the Andean highlands; ii/ The real average nutritional value of a quinoa grain is the one I have on my plate?

Many changes in Quinoa Nutritional Composition can be observed from:

- Environmental issues: Temperature, Precipitations, Salinity, Etc.
- Farmers' practices: Sowing density, Fertilization, Pesticides, Irrigation, Etc.
- Transformation: Post-harvest operations (Harvesting, Cleaning, Selection, etc.), Agroindustry Foods (Milling, Toasting, Extrusion, Fractioning, Cooking, etc.) and Consumer cooking.

In conclusion, they are so many key factors affecting the quality and quantity of quinoa grains during the crop development.

Genotypes (*genetic diversity*) are **only one component** at the entrance of a complex system, and then **many parameters** can affect the nutritional profile of a quinoa variety of high-quality potential.

Considering and ***understanding*** the impact of **each parameter during crop production** is key for determining **the objective or the loss of nutritional quality** during all the process of producing quinoa until food products.

Depending of the environmental conditions, the farmers' practices, and then the transformation process, we can loss very high quantities of some specific **macro or micro nutrients** *(i.e. >80% of proteins).*

Depending of the destination of the product, we don't need the same **nutritional traits** and the same **technological traits** (for specific functions): **choose the right objectives!**