

Protected food, drink or agricultural product name

Product specification for MACA JUNÍN - PASCO

A protected designation of origin (PDO)

Responsible country: Peru

This document sets out the elements of the product specification for information purposes.

Competent authority

The National Institute for the Defense of Competition and Protection of Intellectual Property (INDECOPI) is the Peruvian authority in charge of running the scheme of the appellations of origin and geographical indications.

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Applicant group

Name: The Maca Junín - Pasco's application was submitted by Asociación de Productores y Transformadores de Maca Región Junín - Nación Pumpush, from Peru. However, it must be noted that according to the Peruvian legislation, the Peruvian State is the exclusive owner of the Peruvian appellations of origin or geographical indications.

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Type of product (as in Annex XI Implementing Regulation 668/2014)

Fruit, vegetables and cereals fresh or processed (class 1.6).

1. Product name(s)

Maca Junín - Pasco

2. Description

The vernacular name of the product is MACA, however, there are other common names by which they are known, such as: Andean Ginseng, Peruvian Ginseng, Mace, Pepperweed, among others. MACA JUNÍN-PASCO distinguishes fresh and dried maca. Maca is morphologically described as a typical plant of the Andean highlands with a rosette bearing a crown of basal leaves that arise above a fleshy axis in the ground. Maca is a biennial herbaceous plant that is characterized by the formation of a rosette of short, decumbent stems with numerous leaves and it grows almost attached to the ground, which gives it great tolerance to frost. Within the soil, the part of the stem below the cotyledons (the hypocotyl) acquires a fleshy structure that is integrated with root tissue and ends in a thick root with numerous lateral absorbing roots. This hypocotyl-root is tuberous, succulent and radish-shaped and is the edible part that is highly valued for its nutritional value. These characteristics have made it possible for Maca to thrive under extreme weather conditions beyond 3,950 meters above sea level.

The parts of maca are described below: -

- Root: (hypocotyl), round globose, axonomorphic and napiform. Hypocotyls, commonly known as maca, are the product of the accumulation of reserve substances by the plant, they vary in colour, shape, and size.
- Stem: short and inconspicuous
- Leaves: rosette, compound, with widened pod, long petiole with flattened upper face, compound blade, 6-9 cm long; the basal ones are pinnatifid and caulinar slightly reduced. During the vegetative phase the rosette is only made of leaves and has an average diameter of 30 cm; During the reproductive phase it is made up of leaves and compound inflorescences that can reach an average of 60 cm, even some specimens can measure more than 80 cm in diameter.
- Flowers: the flowers form groups, are hermaphrodite, actinomorphic, light green and very small. Its petals are white, and its sepals vary from green to purple. The flowers gather in panicle inflorescences and the whole forms the rosette of the reproductive phase of the maca.
- Fruit: Maca fruits are silicles that are characterized by having only two seeds, separated by a partition which divides the fruit into two equal portions, the seeds are orange, although the range varies from yellow to orange and brown.

Maca has a wrinkled appearance, which is clear evidence of the contraction of tissues from an early development. Probably during the initial stages of its growth, the upper part of the axis (hypocotyl) would assume most of the thickening as a result of a generalized contraction of the root zone; According to this, the transition region in maca would be rather short. At the same time, the early appearance of secondary cambial activity in the crust would determine the formation of a fleshy body shallow in the soil. The plant is a rosette with a pivot root that forms with the hypocotyl, it is the hypocotyl that is the edible and commercial part.

Some researchers describe maca as small and flattened, with a tuberous root and compare it to radish, with colours such as yellow or purple, or yellow with purple bands. The edible part of the plant is the tuber. The pulp is generally pearl-white and marbled in appearance. It is made up of two well-defined regular parts: a creamy, sugar-rich outer region and a firm, starchy inner region. In the production area, called “Meseta del Bombón”, six well-defined colours have been found, which are yellow, purple, cream, light purple (commonly known as "red"), black and charcoal grey. FAO publications mention that there are at least eight different colorations of the root (which is actually the hypocotyl), ranging from white to purple. In addition, 7 defined forms have been determined in the variability of the Meseta del Bombón (production area).

Both fresh maca and dried maca stand out for their average values of reducing sugar content, which determine organoleptic characteristics such as flavour (sweet), aroma (strong smell attributable to the sulphur chain between its components) and colour; its organic character and the greater accumulation of solids attributable to the absence of irrigation are distinctive peculiarities of MACA JUNIN-PASCO.

The product is characterized by the sweet taste provided by reducing sugars and other compounds such as fats and proteins, accentuated due to post-harvest handling and solar dehydration.

Table 1. PHYSICAL-CHEMICAL AND NUTRIENT PARAMETERS OF FRESH MACA

Main compounds of fresh maca	Common Range to all ecotypes
Moisture (g/100 g)	Less than 74
Fat (g/100 g)	Greater than 2.2
Fibre (g/100 g)	Less than 1.6
Ash (g/100 g)	Less than 2.0
Carbohydrates (g/100 g)	Less than 33
Pure protein (np X 6.25) (g/100 g)	Greater than 3.0
Soluble sugar Direct reducers (g/100g)	Less than 14
MINERALS	
Potassium	<0.6 - 0.9>%
Nitrogen	<1.2 - 2.5>%
Sodium	<0.03 - 0.06>%
Magnesium	<0.06 - 0.75>%
Calcium	<0.27 - 0.45>%
Phosphorus	<0.21 - 0.32>%
OTHER ELEMENTS	
Copper	<2 - 5> ppm
Zinc	<18 - 28> ppm
Manganese	<14 - 35> ppm

Iron	<53 - 110> ppm
Boron	<90 - 230> ppm

Table 2. PHYSICAL-CHEMICAL AND NUTRIENT PARAMETERS OF DRIED MACA

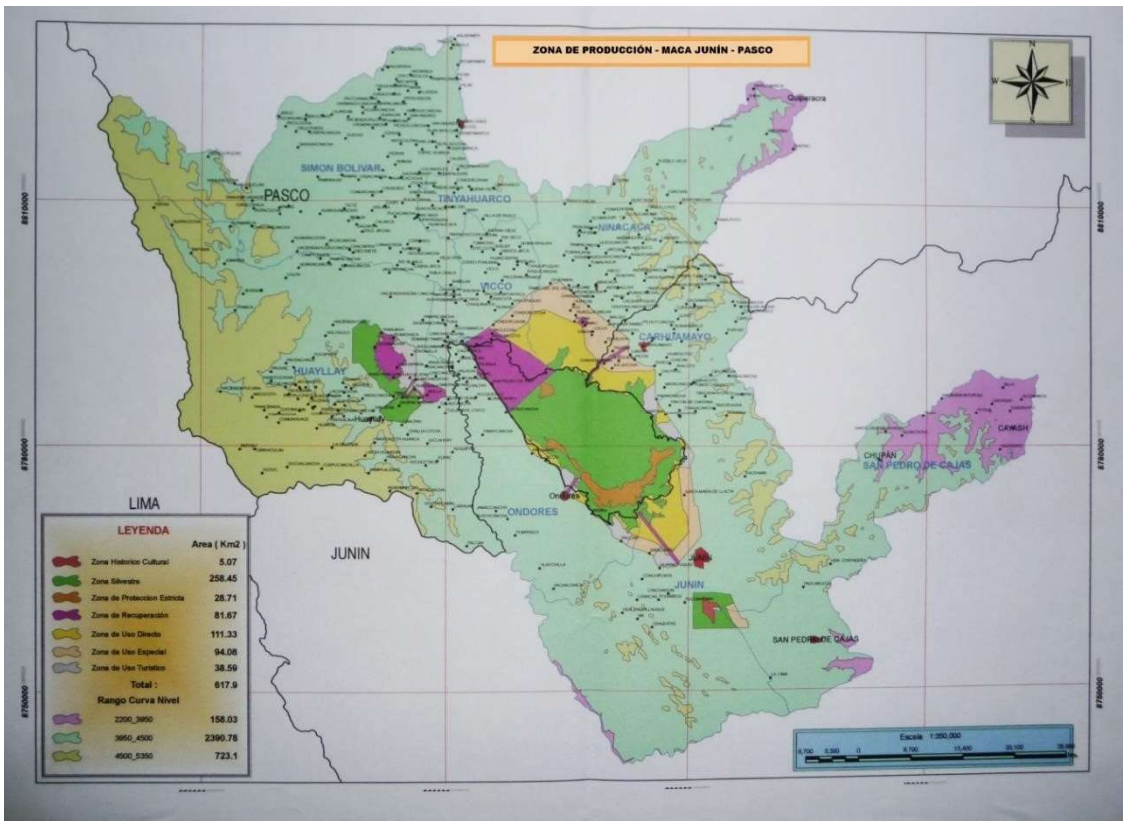
Mineral composition	
Phosphorus (P) (mg / 100 g)	Greater than 200
Calcium (Ca) (mg / 100 g)	Greater than 200
Potassium (K) (mg / 100 g)	Greater than 1,000
Magnesium (mg) (mg / 100 g)	Over 50
Physicochemical characteristics	
Protein (g/100 g)	Greater than 8
Moisture (g/100 g)	Less than 20
Fat (g/100 g)	Greater than 1.0
Fibre (g/100 g)	Less than 6.0
Ash (g/100 g)	Less than 6.0
Energy (g/100 g)	Greater than 290
Carbohydrates (g/100 g)	<60 - 75>

3. Geographical area

The geographical area delimited for cultivation and production comprises the territorial scope detailed below:

It covers the so-called Meseta del Bombón, which comprises the north-western part of the department of Junín and the southwestern part of the department of Pasco, from San Pedro de Cajas, to Vicco, and from Huayre to Ondores, including Junín and Carhuamayo in Junín; and Ninacaca, Huayllay, Tinyahuarco, Vicco and Simón Bolívar in Pasco, in addition to the hamlets and towns that are located within these localities.

It is grown at an altitude between 3,950 to 4,450 meters above sea level.



Map. Maca Junín-Pasco production area

4. Proof of origin

In the first place, it must be taken into account that the producers of Maca are concentrated in community organizations that have the right to use the land according to specific regulations. The management of the land and its use is done collectively, both for its own use and for the lease of third parties.

It must be noted that next to the local government authorities at the executive and legislative levels, the peasant communities are the most important decision-making bodies in the rural area. They have their own directives, regulations and coordination mechanisms with formal governments.

There are different types of Maca producers, classified according to the amount of Maca they grow. Among them can be identified the following: -

Small producer: defined as one who belongs to a peasant community, holder of small extensions of land (0.5 to 3 hectares of Maca). It should be noted that these producers obtain and use their own seeds from previous harvests, generally in an artisanal way.

Medium-sized producer: they are medium-sized farmers or entrepreneurs who lease and/or own land, so they generally have extensions of land greater than 5 hectares. These producers sow selected seeds, produced by themselves or purchased from farmers they consider reliable.

Large producer: they grow crops in areas greater than 30 hectares, between their own and rented. Also, large producers have their own organic certification, in addition to certifying fields of commercial partners (usually small farmers). In addition, they mechanize their operations and carry out pest control.

Finally, it should be noted that there are records of Maca production levels by region and cultivation area.

5. Method of production

Maca has been cultivated in a traditional way since ancient times. Likewise, for its storage, the Peruvian Andean man has developed a traditional process for drying and preserving maca. Although in the past the places where maca was cultivated and conserved for a long time were called pukutos or apachetas, currently the traditional method of conserving maca is in polyethylene sacks and placed on pallets until its final sale.

The period of maca production covers two years and requires two agricultural seasons. It fulfils its life cycle with two well-defined phases:

- Vegetative or Hypocotyl Production Phase (macas). It lasts 8-9 months on average. In this phase, from the botanical seed, commercial macas are produced. The vegetative or hypocotyl production phase generally begins when the frosts end (between the months of September to November) and the first rains begin, since maca is a crop that is managed under dry land. This stage is mainly characterized by the expansion and growth of the hypocotyl (maca) and the root.
- Reproductive or seed production phase. It lasts approximately 5 months. After harvesting the plants of the vegetative phase, the best roots are selected to produce from them, plants with flowers and sexual or botanical seeds that will ensure the next vegetative sowing.

There is an interface between the two aforementioned phases that lasts between 2 and 2.5 months, a transition that serves as a resting phase for the plant (dormancy) to move from one stage to another.

In relation to the practices and techniques used by the producers, during the reproductive or seed production phase, after the plants of the vegetative phase are harvested, the producers select the best roots to produce: (i) plants with flowers and (ii) sexual or botanical seed, which will ensure the following vegetative planting. Regarding the storage stage, after two months of drying, Maca is kept in sacks and stored in a cool place, where there is not much humidity. In this way, in the area where Maca is produced, it can be stored for several years. For its conservation, dry Maca is placed in the attic or wooden platform of the houses or in environments with a ribbed ceiling. Finally, they are stored in sacks, baskets and other reservoirs, preferably made with natural materials where they are kept for up to 4 years or more. Moreover, it is important to highlight that buyers or exporters that purchase dried maca, often supervise the entire planting and harvesting process of fresh maca, as this is the basis for the production of dried maca.

A. Sowing

Choice of terrain
Land preparation
Cleaning
Clearing or "barbecho"
Fluffy, Loosen earth or "cushpeo"
Levelling
Sowing

Agronomic Management

B. Harvest

Drying by sun exposure
Storage
Seed production
Conservation in wells
Conservation with damp towels
Conservation with crabs
Hypocotyl transplantation
Preparation of the land for transplantation
Material soaking and disinfection
Properly Transplant
Cultural tasks and plant care
Harvest Drying

6. Link with the geographical area

The natural and geographical factors present in the production area that directly affect MACA JUNÍN-PASCO are the following:

Climate of the production area:

The MACA JUNÍN-PASCO production area is located in the so-called "Meseta de Bombón". It is made up of a Puna landscape, undulating and extensive areas between 3,950 and 4,450 meters above sea level, and it corresponds to the ecological floor of the Puna, characterized by having temperatures that vary from 4 to 7 ° C, temperatures usually drop during the nights and early mornings to -10 ° C. As a whole, the region is exposed to high solar irradiation, frequent frosts and strong winds. Historical records show the existence of a special and particular climate in the MACA JUNÍN-PASCO production area, since it presents different humidity conditions (around 80%), determined by:

- (i) the incidence of the water mass of Lake Junín,
- (ii) the average precipitation levels and
- (iii) the occurrence of minimum and maximum temperatures.

The humidity records in the contrast regions, oscillate between 60 and 70%. Likewise, the maximum historical temperatures (more than 30 years) indicate differences between one and two degrees, factors that influence the generation of specific climatic conditions for the MACA JUNÍN-PASCO production area. Most of the year, temperatures are below 0°C at night, and during the day they range between 3°C and 7°C, the months from May to September being the coldest. As in most of the Peruvian Andes, the climate is characterized by the sequence of a dry season (May-August) and a rainy season from September to April. It rains on average about 1,400 mm per year, with the months from May to August being the ones with the lowest rainfall. According to the Thomwait method, the zone is defined as the humid-frigid type. Humid due to the high relative humidity content of the area's environment during most of the year, which in annual and monthly average is over 80% and frigid because within the classification made by the National Meteorology and Hydrology Service of Peru (SENAMHI), classifies the area as extremely cold. The MACA JUNÍN-PASCO production area is characterized by having two very particular climatic stages that make it different from other areas where maca is also grown:

Summer and frosts: occur between the months of May to August with an average temperature of 2°C reaching a maximum of 14°C and a minimum of - 7°C.

Rains and snowfalls: which occur between the months of September to April, in which a change in temperature is noted, reaching an average of 5°C, with a maximum of 12°C and a minimum of 1°C. This stage is characterized by the beginning of the rainy season, accompanied by snow and strong meteoric discharges (lightning, thunder).

Moreover, the climate of the MACA JUNÍN-PASCO production area differs from other maca producing and processing areas, due to the following characteristics: Average maximum temperatures in the "Meseta del Bombón" do not exceed 12°C compared to other producing areas such as "El Valle del Mantaro", which is at 19°C. - The average minimum temperatures in the "Meseta del Bombón" is 0.2°C, often reaching -10°C in the months of June and July, while in the other areas the minimum average is 3°C. - With respect to the average precipitation in the "Meseta del Bombón", this is almost double that of the other areas, with 119 mm average per month, while the other zones are in 69 mm average per month. The relative humidity in the "Meseta del Bombón" is more than 20% higher than that of the "Valle del Mantaro", since the former is on average at 82% and the latter at 57%. Therefore, the climate of the production area turns out to be a very special climate, different from other Maca-producing areas, in terms of minimum and maximum temperatures and, above all, precipitation and humidity, because despite of its extreme cold, the humidity and the precipitation give the area a special microclimate.

B) The soils of the production area:

In relation to the soils of the area destined to the cultivation of maca, those classified as Cryorthents cover 45% of the area of the MACA JUNÍN-PASCO production area. These are residual soils, between 3,950 and 4,450 meters above sea level, developed in situ, from consolidated rocks of an acidic nature, made up of shales, sandstones, limestones, and quartzites. Natural drainage is good, they are soils of a dark-to-dark yellowish-brown colour, of medium coarse texture. They are moderately deep to very shallow soils, with a neutral to strongly acid reaction and low natural fertility. Next in importance are the Cryofluvents-

Cryorthents soils (18% of the buffer zone), soils located between 3,950 and 4,450 meters above sea level, formed from material of alluvial and lacustrine origin. The natural drainage is good, they have abundant organic matter, which is found on a stony C horizon, in a proportion greater than 70%. The soils classified as Dystricryepts (16% of the total buffer zone), are located above 4,000 meters above sea level, and are made up of sandstones, quartzites, limonites and shales. They are found occupying slopes of gentle hilly slopes and steep slopes. The relief is wavy to very broken. The drainage is good, it is stony, it is moderately deep. The typical profile of these soils is the ABR, grayish brown in colour, medium texture, with a B horizon of up to 20 cm, placed on a pebble gravel C horizon. The soils of the "Meseta del Bombón" are mostly sandy loam in texture with exceptions for the presence of organic soils, and loamy sand texture in very limited places. The predominant pH in the area is classified as strongly acidic in its greatest extent (values less than 5.5), with the exception of some areas that are moderately acidic and slightly acidic. The floors of the "Meseta del Bombón" have high content of organic matter.

C) Water in the production area:

In the "Meseta del Bombón" irrigation is not used for the production of maca, however, what is relevant is the type of water used in the washing and processing of maca. The analysed water is used to wash the fresh maca destined for its national sale. The indicators considered in the laboratory tests were pH, total conductivity, complete analysis of cations: Ca, Mg, K and Na; and complete anion analysis: nitrates, chlorides, sulfates, and bicarbonates. The water springs determine the water courses that descend from the Eastern and Western Mountain ranges and are part of the systems of lagoons and humid zones of the "Meseta del Bombón". The quality of the water corresponds mostly to the category C1-S1, C2-S1, suitable both for human consumption and for irrigation and washing of the maca in the area. The acidity, nitrate sulfate and heavy metal levels are within the technically and sanitary levels allowed. C1 water only for 27% of the samples taken from the "Meseta del Bombón", these waters represent low salinity danger and no harmful effects on plants and soils are expected. C2 water for 73% of the samples taken in the "Meseta del Bombón". With these waters, sensitive plants can show salt stress; moderate leaching and prevents the accumulation of salts in the soil. All these factors lead to the generation of specific geographic conditions for the production area, which impact on the special characteristics of MACA JUNÍN PASCO. For example, the differences in terms of physical-chemical and nutritional properties of fresh macas from different areas, especially in terms of carbohydrates and sugars, are due to climatic variations and/or the region of origin of the fruits, since there are many factors that determine the amount of sugars present. These factors include the genotype and mainly variables that directly influence photosynthesis such as temperature, solar radiation and soil moisture. Likewise, the ecotypes of the Meseta del Bombón show a superiority of 23.14% over the average value of carbohydrate content of the ecotypes of the Valle del Mantaro and Huancavelica. This is also reflected in the total energy and percentage of kilo calories from carbohydrates, as they are directly related to caloric intake. Also, the samples of fresh maca from the Meseta del Bombón show values from 8.9 to 13.3 grams of total reducing sugars per 100 grams of original sample. The samples from the high Andean parts of the Valle del Mantaro do not present values or these are imperceptible. Reducing sugars determine organoleptic characteristics such as sweetness, flavor, aroma and color, distinctive characteristics of MACA JUNÍN-PASCO. The superiority of fat content presented by the ecotype of the Meseta del Bombón (16.67% more) is closely related to the organoleptic characteristics of taste and smell (essential oils), as well as the secondary metabolites (phytosterols) that are composed or attached to it. Likewise, from the proximal and

mineral analysis tests performed, it is concluded that the Meseta del Bombón ecotype is superior due to its variability and the components that give maca that sui generis sweet flavour, as well as its characteristics smell and colour.

The following are the main characteristics of fresh maca attributable to natural factors:

- The existence of genetic wealth represented in its wide range of colours and shapes (morphotypes) typical of the area for natural conservation. The "Meseta del Bombón" in JUNÍN-PASCO is the only area in the world with such great genetic variability.
- The presence of reducing sugars from the harvest.
- Its high nutritional value considering the high presence of mineral elements and the balance between them.

Its strong characteristic odour (attributable to the sulphur chain between its components).

Also, these are the main characteristics of dry maca, attributable to natural factors:

- Its high index of reducing sugars (which is decisive for the organoleptic characteristics, producing a high content of glucosinolates, among others).
- The drying process in the Junín-Pasco areas is slower and more uniform due to the climatic factor, avoiding the deterioration typical of violent drying.
- The storage time in good conditions and better appearance of JUNÍN-PASCO dry maca, since the characteristic climate of the production area allows the storage of maca for a long time.
- Its characteristic odour.
- Its characteristic flavour (sweet).

In summary, the MACA JUNÍN-PASCO, both fresh and dry, has particular characteristics such as:

- (i) its genetic richness represented in the wide range of colours and shapes (morphotypes) typical of the area for natural and ancestral conservation.
- (ii) the presence of reducing sugars from the harvest and after the drying process (determining for its organoleptic characteristics),
- (iii) Fresh and dried maca have high presence of mineral elements and a good balance between them.
- (iv) its strong characteristic odour (attributable to the sulphur chain among its components),
- (v) its characteristic flavour (sweet).
- (vi) its organic character.
- (vii) the ancestral planting and harvesting practices that contribute to conservation and sustainable use of the soil.
- (viii) the greater accumulation of solids attributable to the absence of irrigation.
- (ix) the ancestral practice of drying maca, among others.

These particular qualities and characteristics are key and are due exclusively or essentially to the geographical environment in which maca is produced in Junín and Pasco. They play an important part in the establishment of the reputation enjoyed by MACA JUNÍN-PASCO (reputation reflected in its volume of production and exports), determining a clear preference from consumers and researchers.

The special characteristics of the product designated by the Maca Junín-Pasco appellation are a consequence of the interaction of natural factors, such as the climate that predominates in the Maca Junín-Pasco production area, as it very special in terms of its minimum and maximum temperatures, because despite the extreme cold of the area, the moisture and precipitation the area have a special microclimate. As the maca grows between 3 950 and 4 500 meters above sea level, on the same Andean Mountain range, it faces adverse climatic conditions, since it is land with stony and frozen soil, great solar and cosmic radiation, low atmospheric pressure and where hail is not unusual. All these factors influence the generation of specific environmental conditions for the Maca Junín-Pasco production area.

Throughout the MACA JUNÍN-PASCO production area, producers have preserved the varied richness of the different ways of genetic expression of maca, represented mainly by its colour and shape. This conservation is generally carried out in places where maca has been planted since ancient times and by people who empirically give each of them a particular use, mainly because of their colour. MACA JUNÍN-PASCO producers are experts and have the necessary skills to carry out all the activities of the production process that include the choice, preparation, cleaning, and management of the land.

Likewise, they have the necessary expertise for sowing, agronomic management and the different stages of the harvest that includes, for example, conservation in ponds, which is a technique used by producers since Inca times. It should be noted that the main human factor currently is in the planting, harvesting and drying of maca, to produce fresh and dry maca. The techniques used by the producers are of ancestral heritage, supported by legends and archaeological remains. Moreover, regarding the storage process, producers have developed a traditional process for drying and storing maca. Although in the past the places where maca was grown and stored for a long time were called "pukutos" or "apachetas", currently the traditional method of preserving maca is in polyethylene bags and placed on top of pallets until its final sale. Another example is cultural work and caring for plants. Once the hypocotyls have been transplanted into the definitive field, after a week if there was no rain, the field can optionally be irrigated to favour better installation and regrowth. After two months the producers proceed to weeding. This practice must be carried out very carefully, trying not to damage the generative branches too much, since these are the ones that will give rise to the flowers, fruits and, later, seeds. Producers proceed as follows:

- With the palm of their hand, they carefully lift part of the plant.
- Insert the weeding spatula and with it they cut the weeds.
- Extracted weeds are removed outside the seed field.

Regarding the influence of the human factor in fresh maca, the following should be taken into consideration. In the production area irrigation is not used to produce maca, nor is fresh maca washed before proceeding to dry it, while in the upper parts of the Valle del Mantaro irrigation is used and fresh maca is washed, since it is marketed fresh. The deliberate use or non-use of irrigation constitutes a human factor that affects the characteristics of the product because the greater accumulation of solids in fresh MACA JUNÍN-PASCO is mainly attributable to the absence of irrigation and washing.

Producers do not use agrochemicals, since they use "purum" or rested land, in which no other product is planted. This practice has allowed them to access organic certifications. Currently, 78 producers that cover 214.7 certified hectares have said certification. Organic certification requires strict compliance with principles, rules and regulations, as well as adequate documentation and traceability. The preparation of the land by the producers for planting allows

the soil to be conserved, avoiding erosion, exposing the roots of grasses and weeds to the sun, allowing them to dry, disintegrate and fertilize the land naturally. It also protects developing plants from frost and prevents the invasion of weeds during the entire growth period of the maca. The practice of "cushpeo", which consists of breaking up or breaking the champas until the ground is uniform, leaving clods on the ground in order to create a suitable microclimate for seed germination. The practice of leveling the land serves to avoid flooding and drowning of plants due to excessive accumulation of water. The sowing is done by broadcasting because the seed is very small. This seed is mixed with soil to have a better distribution in the field and then it is covered or buried by trampling it with a herd of rams, with bush branches or with rakes.

Finally, regarding the influence of the human factor in dry maca, the following should be noted. Junín and Pasco are the only areas where intensive sun drying is carried out. In other words, this human factor is present only in the area covered by the appellation of origin. The producers do not wash the maca, which allows the water-soluble glucosinolates not to be lost. Glucosinolates are necessary for the generation of reducing sugars, which determine odor and flavor characteristics.

Regarding the Maca Junín-Pasco denomination, it is made up of the words, JUNÍN, which corresponds to the department and region of the same name, located in the central part of the Peruvian territory. For its part, the word PASCO, corresponds to the department and region of the same name, located in the central zone of Peru. Maca Junín-Pasco is grown at an altitude between 3,950 and 4,450 meters above sea level.

7. Inspection body

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8. Labelling

Peruvian Metrological Standard NMP 001: 2019 "Requirements for the labelling of pre-packages" - 5th edition, as applicable.

