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POTATOES CRISPS QUALITY FROM FIELD TO FINISHED PRODUCT

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Abstract: *The following descriptions provide a listing of the critical specifications for the raw materials which are used in potatoes crisps production. An unacceptable number of quality deviations must be detected during the process in order to isolate the reasons for these deviations. There are also presented measures during of crisps production in order to avoid process fluctuations.*

Keywords: *potatoes, starch, processing, chips*

1. INTRODUCTION

The quality of the raw materials has a significant influence on every step in the manufacturing process. As a consequence, if the raw material already is under standard at the beginning or it gets worse during the storage in the plant, the finished product specification cannot be met.

2. TECHNICAL REQUIREMENTS

2.1 Potatoes. Conducting harvest in a timely manner is critical in the production of high quality potatoes that are in demand by the market. A timely harvest will not improve the quality of the potatoes, but a crop can be lost if harvest is not timed appropriately.

All irrigators strive to eliminate soil moisture deficits to produce a high yield of good quality potatoes. Irrigators must understand both soil-water and crop characteristics, in order to determine when and how much to irrigate.

A wide range of insect, disease and weed pests can attack potatoes. The key to successful production of potatoes without the use of synthetic pest control products is prevention and plant nutritional health. Potato fields that have been planted properly will produce complete stands of uniform plants. With adequate mid-season management, they will produce high yielding, top quality, and profitable crops. (Fig.1)

Plant misses result from seed decay, planter skips or blind seed pieces. A plant adjacent to a "miss" produces higher than average yield. However, the increase is not sufficient to compensate for the zero yield of the missing plant.

Plants adjacent to misses generally produce oversized tubers that bruise more easily and are more subject to hollow heart, knobs and deformities.

Production costs for a field with a poor stand of variable plants are the same as those for a field with a high stand of productive plants. (Fig. 2)

Figure 1 - Good plant stand



Figure 2 - Poor plant stand



Planting into soil of the proper temperature is important to ensure a healthy stand of potatoes, especially when planting fresh cut seed. Wound healing of fresh cut seed takes place when soil temperatures are between 55-60°F (13-16°C). This temperature also encourages quick emergence without promoting the growth of seed piece decay organisms. Planting unhealed seed pieces in cold soils delays emergence and increases the risk of seed piece decay resulting in a poor plant stand. [4]

Before every converting process, the workplace and the equipment must be checked to assure that they are clean and free from all raw, products, product remains or articles not required for the planned operations.

The raw product potato has the greatest influence on the quality of the finished product. With potatoes for potato crisps the quality will be influenced by such factors as: kind, cultivation, handling of the raw material including storage.

Very important factor in potatoes processing is

starch content in tubers. A high content of starch means good productivity (slices are more heavy). (Fig. 3)

The dimension of the potatoes for the production of potato crisps can be adjusted to the packet dimension (35-70 mm). For this the potatoes must be calibrated accordingly. For small bags small nodules are desired, while bigger nodules are preferred for bigger bags. The form of the nodules is very important for the production because it has an influence on the peeling losses.

Regarding potato storage emphasis is placed on receiving the nodules in the best processing state during the storage period. With ideal storage no germ formation occurs. Additionally, no formation of sugaring or other substances should occur by which the potato crisps would take on a dark color.

The storage units for the potatoes are controlled for light, temperature and moisture in such a way as to allow for a sufficient quantity of qualitatively flawless potatoes to be available for a longer period of time.

The transport of potatoes in boxes or containers and their filling must occur in such a way that damage, wear, cutting and the formation of pressure points is kept to minimum. Regular samples, for example weekly, must be taken from the storage to determine if any defects to the potatoes have occurred in the interim.

The nodule aeration must adhere to during the storage. Appropriately positioned fans help to hold the temperature and aerial humidity within these areas.

Insufficient airings result in the quick formation of carbon dioxide in the surroundings and moist parts of the potatoes.

The potatoes contain, as a rule, approximately 85% water. The potatoes will begin to shrivel if the relative humidity moisture falls below 80% during the storage. The yield of the potatoes is thereby lowered. Therefore, moisture from > 90 % for the whole storage period should be maintained.

The storage has to be patrolled regularly and problems handled accordingly (during storage period) and disinfected (if storage is empty) to minimize the contamination by insects and rodents.



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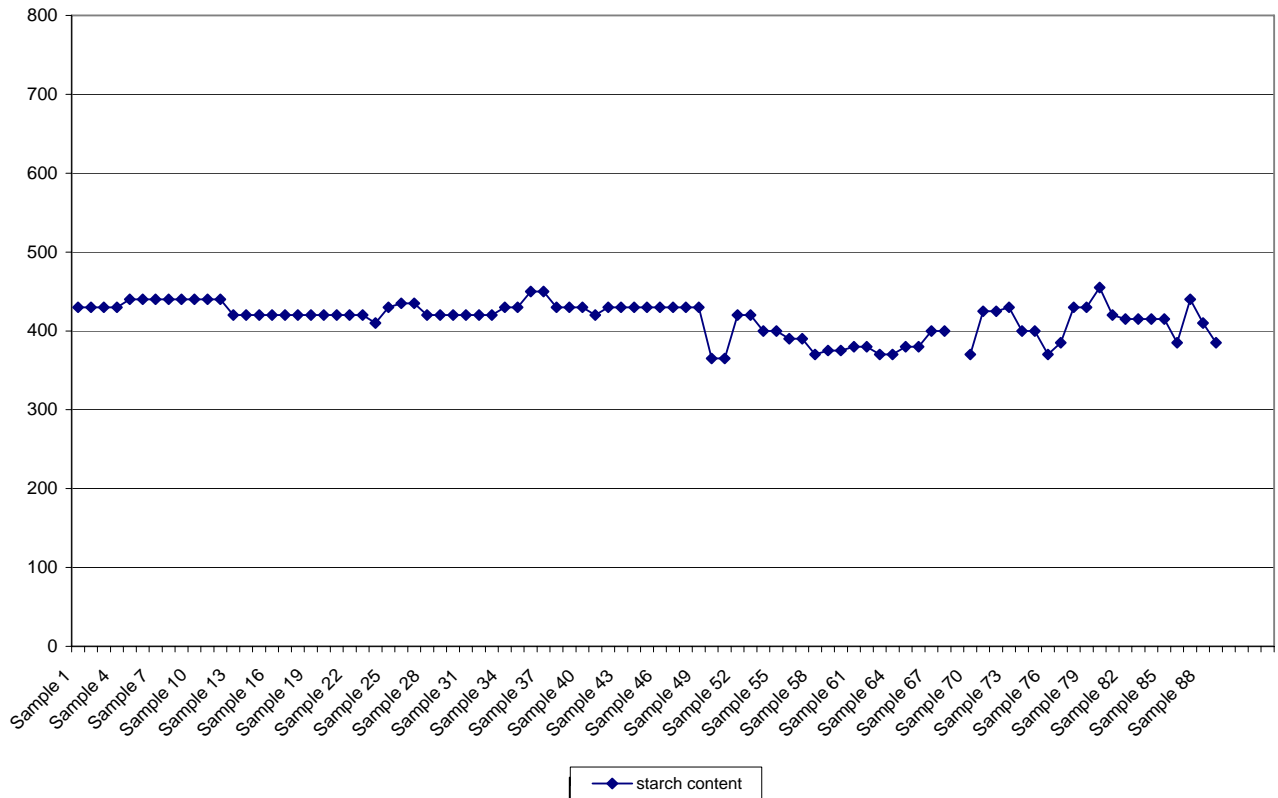
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Figure 3 - Variation of starch in potatoes



2.2 Frying oil in general. Fat is (in chemical terms) a combination of the 3-valued alcohol glycerin with 3 fatty acid residues which are tied together around a so-called Esterbindung. The fatty acids are differentiated based upon their reaction properties into "saturated" and "unsaturated" ones.

Due to health controversy surrounding the trans fatty acids is recommended to be used only fat that contains small quantities of trans-fatty acids and lies in the melting points so low that sensorial properties have been maintained. This is achieved by the fractionating of oils. For this process different oils are suited, as for example sun flower oil (High Oleic Sunflower) as well as Palm Oil (Palm oil fractionated). To protect sensitive oils against

oxidation, manufactures often add tiny amounts of antioxidation mediums, as for example Butyliertes Hidroxianisol (BHA), Tocopherole (vitamin E) or Ascorbylpalmitate. The optimum storage temperature is 10 °C above the melting point of the oil. [3]

2.3 Flavors. Spice aroma mixtures provide the taste of potatoes crisps. They are made up primarily of the following ingredients: salt, sugar, taste amplifier, yeast powder, yeast essences, seasonings, herbs, vegetables, fruits, cheese powder, acids, aromas, view particle/herbs, colorings.

Storage has an essential influence on the sensorial stability of aromas (flavors). On this front, it is subject to such factors as: temperature, aerial moist, light, time and kind of packaging.

These are the most important factors which can influence the durability and therefore the sensorial stability of the crisps made from it.

Storage terms are as followings: cool (maximum: 20 °C, minimum 12 °C), dry (relative moisture 50%, maximum 70 % at times), dark (well packed in closed containers).

2.4 Crisps production. In this step of the process a raw potato, either from the potato storage or directly from the supplier, is processed into a white potato.

While destining all stones and foreign bodies which are heavier than potatoes, must be removed.

Next step is potatoes washing. The washing is a wet cleaning process. The target of the washing is to create sandy free, sterile potatoes free of organic matter. The fresh water application may not fall below 0,5 m³ per tone of potatoes. The water interchange rate should be 0,3 x per hour. The conductivity of the cold water in the washing apparatus is to be collected at regular intervals (1 x shift). It may not exceed 600 µ p./cm about the base value of the fresh water. So that microbiological process is halted, the cold washing water may not be warmer than 20 °C.

The washed potatoes are than peeled. For this process an abrasive peeler is used; it is controlled by the following parameters: peel time, filling degree, batch amount, water application, transport of the peeled potatoes.

Before potatoes cutting it is necessary a potatoes examination by one or two persons. Strict inspection must be carried out and defects must be manual removed by cutting the defect area, or if it necessary, by removing the whole potato.

The dosing potatoes dosing before cutting determines the flow rate of the whole line. The measured potato amount must be steady. Achieving a high exactness the application of a gravimetric dosage is recommended.

Potatoes slice cutting is a very important step of the process. The slice thickness is a major parameter which has a basic influence on the different quality criterions of the finished product. A constant thickness means an uniform humidity, an uniform fried slices, no bubbles and no greasy aspect. To achieve

these parameters it is also important to change knives periodically, at every maximum 2 hours. During cutting step fresh water is added. To prevent the build-up of starch and small parts, a steady fresh water flow must be guaranteed in the cutter. Immediately after cutting of the slices, an intensive cleaning must be done. The main cleaning process can be connected by conveying the slices. All other washing steps are to be performed and operated so that an excessive washing-out is avoided. A technical measurement of the water quality is to be continuously collected in the washing apparatus. The conductivity in the cold washing water of the first cleaning step may not exceed 1500 µ p/ cm above the base value of the fresh water. The water exchange rate for every cleaning step in the washing system should be at least 1 x hour.

Due to the fact that potatoes have a high percentage of unwanted sugaring and free amino acids in particular, at the end of storage period, measures must be taken to decrease the content of sugaring in the potatoes slices. The method recommended for removing the undesirable sugar is blanching with hot water. The blanching temperature (water temperature), measured in the product outlet of the blancher must be at least 83 °C, so that the slice temperature can reach 80 °C. The blanching time is between 2 and 3 minutes, depending of the slice thickness.

To compensate partly the sensorial defects which appear by blanching the slices, the retexturing must be integrated after blanching as a texture-establishing procedure into the process completion. Retexturation is made usually with Calciumlactats.

Slice separation is made with spread water. To much adhesive water in the frying oil require unnecessary high energy expenditure. Compressed air by air nozzles blows from ventilating fans the adhesive water off the surface of the slices.

Washed slices, partially dried go through the deep fryer to be steadily deep-fried in hot edible oil. The process of deep frying is divided into three phases which vary depending upon the aid of the physical processes: vaporization, drying and cooling. The driving factor for the vaporization is the



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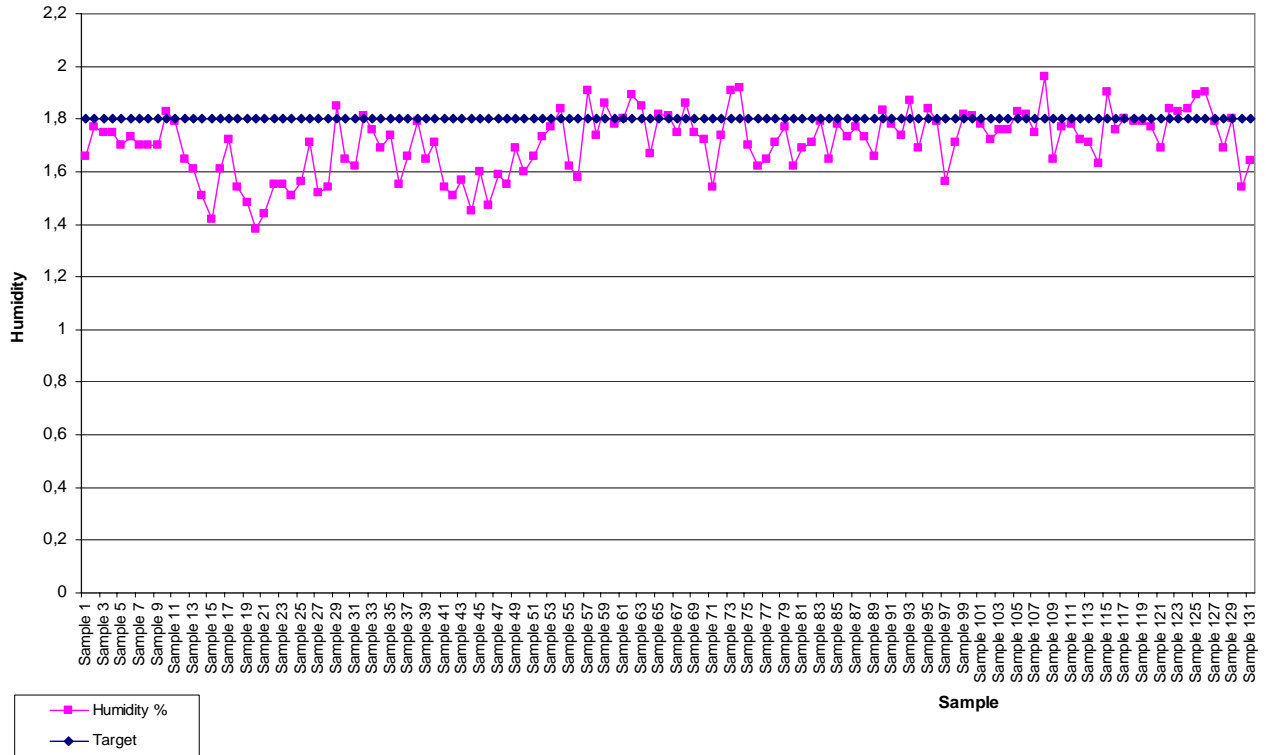
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Figure 4 – Humidity level in fried potatoes slices



oil temperature. The higher the temperature, the more intensely and the shorter is the deep frying process. The entering temperature is between 180 °C. This temperature range may be left only to produce special crisps with a higher fat content. The temperature must be stabilized by using a regulator and may vary in the stable state maximum of an area from +/- 0.5 °C around the set nominal value. [1]

Deep fried is basically up to the moisture defined in the specification, normally within 1-2%. If the moisture sinks less than 1% undesirable effects appear like excessive fatness, darker coloring, burnt taste and a high Acrylamide value. (Fig. 4)

Deep fryers are to be designed with a temperature difference of 15-20 K. Therefore the outlet temperature is normally between 160 – 170 °C. In case of special requirements, like

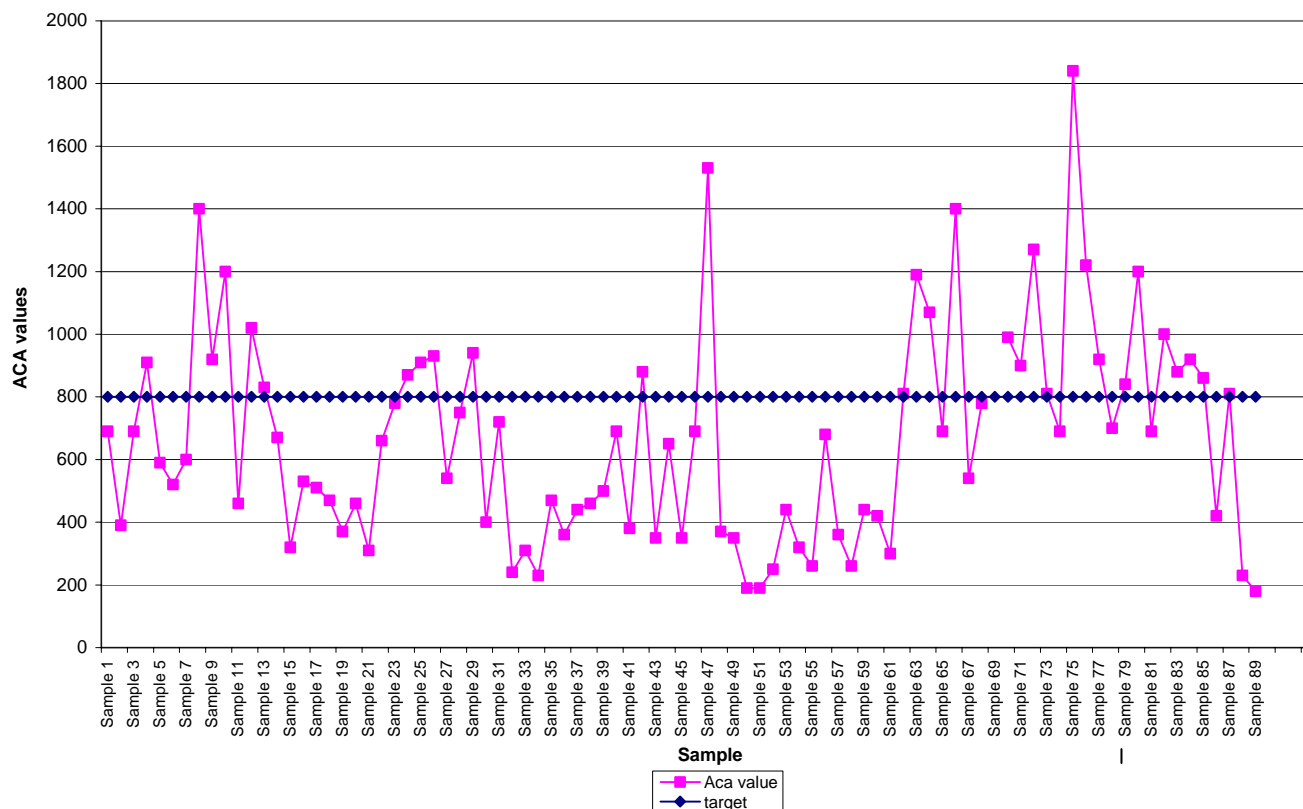
the reduction of undesirable conducted substances which can originate during the deep- frying, the outlet temperature can be lowered to 150 °C. Deep-frying less than 150 °C outlet temperature is to be avoided. [2]

At this point the transport of crisps into the deep fryer is carried out by special conveyor facilities which also allows for dwell time regulation. Wheels or flap belts convey the slices through the fryer trough in the form of a stopper current (plug-flow).

In order to control the moisture percentage, an on-line measuring sensor in the discharger of the deep fryer must be installed. The controlling station is to be installed at the point after which the crisps have already left the oil batch for 25-30 seconds.

Taste is developed primarily in the last phase of the deep-frying process.

Figure 5 – Acrylamide content in chips



Fried slices with defects (black spots, green parts, too dark color) are removed in the next two steps of the process: optical sorting and manual sorting. Optical sorting is made before flavoring and the manual sorting is made after slices flavoring. Before seasoning, the crisps must be cooled by the outlet temperature of the deep fryer (120 °C) to achieve the optimum temperature for seasoning. A too low seasoning temperature (< 60 °C) as well as too high temperature (> 80°C) is to be absolutely avoided. Flavoring is made in a seasoning drum, where the spice aroma mixture is steadily dispersed on the crisps in a rotary mixing drum.

The potato crisps are bunkered after manufacturing. Then they are conveyed from the bunker over a transport distance and into the packaging area.

Packaging machines weighing automatically the product and the half finished product is packed into bags and they are put in boxes.

3. CONCLUSIONS & ACKNOWLEDGMENT

All aspects of the manufacturing process must be focused on the careful treatment of the potatoes, slices and crisps. The individual manufacturing process must be done in compliance with the provided instructions, procedure descriptions and in accordance to production good manufacturing practices. Adequate and sufficient means must be available for the realization of these control measures.

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