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Vegetable brandies

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- Fennel, pumpkin, carrot, beet, sweet potato, (gentian): Information on composition and recommendations for mash preparation and fermentation -

Spirits law:
According to the new EU Spirits Regulation 2019/787, vegetables may either be fermented as a mash and distilled into **vegetable spirit** or processed unfermented into vegetable spirit after maceration in fine spirit. Both end products require a minimum alcohol content of 37.5% vol. Vegetable spirit may be rounded off with up to 18g, vegetable spirit with up to 10g sugar/liter.

The following explanations relate to mash preparation and subsequent fermentation. They may help experienced distillers to plan vegetable processing with their existing equipment.

Raw or cooked?
This must be decided on an individual basis. Unless the loss of flavoring substances speaks against it, cooking the vegetables can facilitate mashing and promote clean fermentation. However, hot processing of vegetables with a high starch content is essential.

What is fermentable at all?
Compared to fruit, most vegetables only contain small amounts of directly fermentable sugars. The alcohol yield from vegetables that do not contain starch is correspondingly low. In addition to directly fermentable sugar, some vegetables also contain some starch (easy to detect with the **iodine starch test** for **distillers**). It can cause the dreaded sticking in the still during distillation of the mash. As with starchy fruits (e.g. unripe apples, peaches), this can be countered during mash preparation without heating by enzymatic starch degradation with **amylase GA 300** or **500** (dosage approx. 10-20ml / 100kg vegetables), but a noticeable increase in the alcohol yield is hardly to be expected.

Saccharification of the starch
Vegetables with a high starch content require - similar to potatoes - hot processing with appropriate enzymation. Only the liquefaction of the starch by the enzyme **Schliessmann VF** (approx. 5ml/100kg) while keeping the mash hot at 75-80° C for approx. 30 minutes ("liquefaction rest") and the subsequent saccharification with **Schliessmann VZ** (approx. 20ml/100kg) after rapid cooling of the mash to 55°C produce complete alcohol yields.

Cleaning the raw material
As all vegetables grow and ripen in the soil or directly on its surface, adhering soil, sand and clay must be removed extremely carefully to ensure flawless, low-bacteria fermentation. This requires considerably more effort than the usual fruit washing, especially in the case of roots. Moldy and rotten raw produce is of course sorted out beforehand. Incidentally, cooking the unchopped vegetables or heating the chopped raw vegetables also helps to kill off micro-organisms that are harmful to the mash.

Shredding
The aim of mashing is to produce a liquid mash that can be stirred and pumped. The firmness of the raw vegetables requires them to be ground as finely as possible in a musher, grater or scraper mill.
Cooking the unchopped vegetables softens or even dissolves the vegetable tissue. They are then blended by squeezing, mixing, whisking or straining.

Mash liquefaction

Mashes that are not yet stirrable after crushing and to which no water is to be added should be liquefied by adding a pectinase (**ULTRA "Fruit"** or **pectin-lyase**, approx. 10ml/100kg). It should be noted that both preparations lose their effect at temperatures above 60°C. For this reason, they should only be added after the mash has cooled to below 55°C during hot processing.

Fermentation under acid protection As vegetables only have a very low natural acid content, they are much more susceptible to rotting and incorrect fermentation than fruit. This makes it all the more important to ferment the mash under artificial acid protection (acidification with **PM acid** or **acid combination MS**) in addition to the immediate mashing of the freshly harvested raw produce. Notes on acid dosage:
Mashes made from **starch-free** or **low-starch**, hot or cold chopped vegetables can and should be adjusted to a pH value of 2.8-3.2. In contrast, the pH value in mashes made from **starch-rich** vegetables that are processed hot for the purpose of enzymatic starch digestion must not exceed
- after the liquefaction rest
- during the cooling of the mash at around 55°C and
- must not be lowered below 4.5!

The reason for this lies in the pH requirements of the enzyme preparations:
- (**Schliessmann VF:** pH 5,5-7,0;
- **Schliessmann VZ:** pH 4,5-5,5)

Mixing and fermentation temperature

Due to their perishability, vegetable mashes should be fermented warm and vigorously, or at least very quickly at around 25-35°C. If no mash heating is planned,cleaning with hot water warms up cold-harvested or cold-stored raw vegetables. Hot mashes, on the other hand, must be cooled to an appropriate pitching temperature of 28-33°C for fermentation, taking into account the heat of fermentation that is generated later.

Yeast
Low-starch vegetables can be fermented well with **TOPIFERM** or **AROMA plus**, while starchy vegetables are better fermented with **KORNBRAND premium**. Those who like to experiment will also create special distillates with **OPTI Fruit plus**, our yeast blend known for its pronounced aroma development in fruit and honey wines. The dosage of dry yeast should be based on the sugar / starch content of the raw material, its fermentability and the temperature in the fermentation room: 40g/hl Mash for low-sugar mashes in a cool environment, around 20g/hl for starch and sugar-rich vegetables and warm fermentation rooms. Root vegetables and gentian, which cannot be cleaned properly due to their shape, can only be fermented reasonably cleanly with an even higher yeast dosage.

Yeast nutrition
Experience has shown that starchy vegetables require little or no additional nutrients because they provide the yeast with sufficient nitrogen due to their higher protein content. Mashes from low extract, watery vegetables, on the other hand, should be provided with 20-30g/hl **DAP** or **distilling mash nutrient** on the second day of fermentation. Roots that are difficult to ferment and contain substances that inhibit fermentation, such as gentian or ginger, require a higher dosage of yeast nutrition. The following information on individual types of vegetables and roots is taken from specialist literature:

Vegetable fennel
- up to 6% fermentable sugars,
- Medium run yield of up to 1.5 liters of pure alcohol from 100 kg,
- Distillate has an aniseed-like aroma.

White or green asparagus
- up to 2 or 4% sugar,
- Center run yield up to 1L,
- Distillate typical of asparagus.

Beet / Beetroot
- up to 9% sugar,
- Medium yield of up to 2.5L
- Distillate earthy, root-like.

Carrots
- up to 8% sugar,
- Center run yield up to 2L,
- Distillate pleasantly typical and very intense. Possibly hot processing

Pumpkins
- Fermentable substance depends on variety, e.g. Hokkaido up to 7% sugar and 7% starch, musk pumpkin up to 4% sugar and almost no starch,
- Center run yield 1 to 3,5L,
- Distillate very typical. Low-starch, aroma-rich varieties should be processed raw to preserve their aroma, while high-starch varieties should be processed hot.

Sweet potatoes
- up to 5% sugar and 20% Starch,
- Center run yield up to 7L ,
- Distillate fruity, very unique. Absolutely hot processing!

Enzian (not a vegetable spirit, but category no. 18 of the "Spirits"-VO (EU) 2019/787
- up to 15% sugar iin the fresh root,
- Center run yield up to 3,5L,
- Distillate typical and very intense, but not bitter.