



# Application note

## PrOatein in meat analogues

PrOatein is an oat protein concentrate that contains an average of 55% protein and can be used in the production of textured vegetable protein (TVP), in high moisture extrusion (HME), or as a powder in a formulation containing TVP from a different source. It is a light brown powder that has cereal taste and low bitterness.

Oat protein has an amino acid profile with low content in lysine and high content in sulfuric amino acids. Therefore, combining it with legume proteins provides a complete amino acid profile.



# PrOatein in Textured Vegetable Protein (TVP)

The TVP produced using oat protein has an excellent texture and fibrousness that makes it suitable for minced meat, hamburger, and meatballs applications. Additionally, the oat protein TVP has a milder aftertaste which reduces the need for flavour blockers in the final product.

## Level of Inclusion

Combining 30% oat protein with 70% pea protein isolate provides a TVP with a hardness level that is suitable for hamburgers. It is also possible to produce a TVP with up to 70% oat and 30% pea isolate. The characteristics of this TVP are more suitable for pulled plant-based “meat” or canned plant-based “tuna” type of products, being characterised by having a higher fibrousness and dryness, similar to that of pulled pork.

## Extrusion parameters:

Oat protein has different intrinsic characteristics than other plant-based proteins. It is therefore important to remember that different parameters need to be applied when extruding oat protein.

### Screw configuration

The screw configuration is of high importance in the extrusion process. A screw that contains both forward and reverse elements to ensure high residence time in the barrel and high shear applied is recommended, such as the one shown in the picture below.

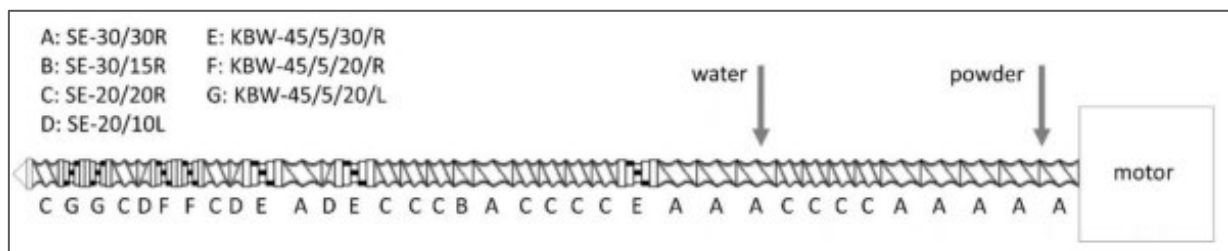


Figure 1: type of screw configuration recommended when working with PrOatein

In this screw representation, single letters correspond to the manufacturer's screw part codes as presented in the top left corner of the picture, where:

- SE corresponds to conveying element
- KBW corresponds to kneading block
- R: forward element
- L: reverse element

## **Temperature**

PrOatein has a higher melting temperature than other plant proteins, such as pea and soya. Therefore, higher temperatures are recommended.

When introducing 20 to 50 % oat protein, temperatures between 135 and 155 °C can be used to produce TVP. However, in blends with high content of oat protein (70%) a higher temperature is required to achieve a fibrous texture (140-160 °C).

In general, the higher the temperature applied, the higher the moistness of the end-product and the fibrousness. Additionally, decreasing the temperature provides with less bitterness and less hardness in the TVP.

## **Dough moisture**

Water contents of 25-35% are recommended. The lower the dough moisture, the higher the oil holding capacity, the overall taste intensity, and the hardness of the TVP. Lower moisture content makes it easier to achieve pleasant hardness in the rehydrated end-product.

## **Screw speed**

When introducing 20 to 50 % oat protein, screw speed between 525 and 700 rpm can be used to produce TVP. However, in blends with high content of oat protein (70%) a higher screw speed is required to achieve a fibrous texture (1060 to 1200 rpm). This is possibly due to the higher fat content of the mixture, which can have a lubricant effect in the barrel and screw.

# PrOatein in High Moisture extrusion (HME)

It is possible to produce meat analogues with good fibrousness using PrOatein in HEM, both alone and in combination with other plant-based proteins, such as pea protein.

The benefits of the combination are a milder flavour profile when introducing the oat protein, a complete amino-acid profile, and a final product with high fibrousness.

## Level of inclusion

It is possible to include different levels of PrOatein when developing products extruded at high moisture. Extruding 100% PrOatein will provide with a product with good fibrousness. Adding pea to the formulation (70% pea and 30% Oat) will give a product with long and strong fibres.

## Extrusion parameters

Due to the intrinsic differences of oat proteins, different parameters need to be applied during extrusion process, when compared to using other proteins such as pea.

### Screw configuration

It is also recommended in HME to work with a crew configuration with conveying and reversing elements to apply high shear and ensure a long residence time in the barrel, such as the one depicted above (Figure 1).

### Temperature

When working with oat protein, higher temperatures are recommended. In the internal tests performed, a temperature profile that increases gradually to reach 140°C proved to give the best results regarding texture and fibrousness for all pea/oat combinations tested, including 100% PrOatein.

### Dough moisture

The inclusion of oat protein requires lower dough moistures. For a 30% Oat – 70% Oat protein combination, the optimal dough moisture is 50 to 53% water. When extruding only oat protein, the water content should further be reduced to 47-50% water content.

## Screw speed

Higher screw speeds are required when extruding oat protein when compared to soya and pea. When extruding a 30% oat and 70% pea protein combination, 800 rpm were required. When the oat protein content was increased to 100%, 1200 rpm were required.

## Remarks when extruding PrOatein

### Fat content

PrOatein contains an average of 13% fat. Fat, in general, lubricates the screw and decreases the specific mechanical energy. However, the fat in PrOatein is bound in the matrix, and it has less lubricant effect than free fat. It is nevertheless recommended to combine PrOatein with other protein isolates of lower fat content in order to reduce the fat in the mix.

### PrOatein melting temperature

The protein melting temperature in PrOatein is higher than in other proteins. The melting temperature is related to the denaturation temperature, which, as a reference, is 78-92°C in soya protein and 78–82°C in pea protein. In oat protein, however, the denaturation temperature is between 100 and 110°C. Therefore, PrOatein needs higher temperatures, longer residence time in the barrel and stronger treatments to achieve the melting temperature.

### PrOatein concentrate

PrOatein contains on average 55% protein. It is recommended to have a protein content of 60- 70% in the flour mixture for the extruder to produce a product with a good texture. It is therefore recommended to combine oat protein with another protein isolate.

*\*Disclaimer: all tests performed to produce this application note were carried out using a Brabender twin screw extruder, and some differences in parameters may be observed when using different equipment*

# PrOatein as a powder in the final meat analogue formulation

PrOatein can be used together with TVP or other protein sources in order to increase the protein content in the formulation and achieve a complete amino-acid profile. Other benefits are a mild flavour (compared to introducing a protein powder from another source) and being able to include the positive image of oats in your product.

## Formulations with PrOatein in meat analogues

It is easy to formulate a product using PrOatein in the final formulation of the meat analogue. PrOatein is a free-flowing powder with good wettability. It does not form lumps and it can therefore be included easily into the final meat analogue formulation. It has low water absorption (2 grams of water per gram of powder) and it is also stable when used across a wide range of temperatures and pH.

## Prototype recipe: vegan hamburger

In this recipe, protein is added to increase the protein content to 13.9%. Therefore, burger patties of 120 grams contain 16.7 grams of protein.

Ingredients	%
Rehydrated textured vegetable protein	59.24
Water	10.67
Ice	10.67
Rapeseed Oil	6.49
PrOatein	7.60
Flavour mix for vegan hamburger*	3.79
Hydrocolloids mix for vegan hamburger	1.54
<b>Total</b>	<b>100</b>

## Preparation

1. Combine the spices mix with the rehydrated TVP and PrOatein
2. Create the emulsion:
  - Using a high shear mixer, mix the water and the ice. Blend at high speed and control that the temperature of the slurry remains below 4°C
  - Add the hydrocolloids mix under shear
  - Add the oil gradually while blending
3. Let the emulsion rest at refrigeration temperature for 20 minutes.
4. Add the emulsion to the rehydrated TVP and combine until a homogenous mixture is achieved
5. Form the burgers into 120-gram patties
6. Cook the patties in a grill or hot pan lightly coated in oil.

Nutrition facts	Per 100g	Per serving (120g)
<b>Kcal</b>	154 Kcal	185 kcal
<b>Protein</b>	14 g	17 g
<b>Carbohydrate</b>	4 g	5 g
<b>Fat</b>	8 g	9 g
<b>Fibre</b>	5 g	7 g