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FUNCTIONAL VEGETABLE FAT PASTE

Khudoykulov Anvar Shavkatovich
Bukhara engineering technological institute

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Abstract:

The oil and fat industry is currently facing fundamentally new tasks that cannot be solved by a simple quantitative increase in production volume, but require qualitatively new approaches, including the production of vegetable fat products for healthy and safe nutrition of the population. Fatty products traditionally belong to mass consumption products and, accordingly, they are justifiably the object of enrichment of their prescription compositions in order to obtain nutritionally adequate food products.

Keywords: interesterification of fats, sesame paste, flax seeds, oilseeds

In order to change the composition and properties of fatty products in domestic and foreign practice, methods of selection and genetic engineering of oilseeds, fractionation and enzymatic interesterification of fats and oils, mixing (blending) of oils of various crops, including non-traditional plant sources, are being developed and applied. Complex innovative products obtained by changing the composition of the fatty phase in terms of the amount and ratio of polyunsaturated fatty acids (PUFAs) of the ω-6 and ω-3 families by blending various oils have the greatest potential in the segment of enriched products. The advantages of using vegetable oils to correct PUFA deficiency over biologically active additives (BAA) containing them and drugs are that oils are a food product to which the human body is adapted, and they are also much cheaper than dietary supplements.[1-6]

However, the growing demand of industry and the population for functional vegetable fat products intended both for direct consumption and for use in the production of a wide range of food products, such as bakery, confectionery, necessitates new innovative developments to obtain such products.

The task of improving technologies and optimizing recipes is to select such components and determine their ratios, which provide the maximum approximation of nutrient mass fractions to specialized standards. Mixing fats and vegetable raw materials is an effective technological method for achieving a given ratio of functional nutrients, including fatty acids of various types, by creating 2- or multi-component systems. To create such systems, it is recommended to take the most accessible, technologically convenient and widely used in the production of fats, oils and vegetable raw materials.[7-12]

One of the vegetable-fat systems with excellent taste and physiologically beneficial properties, as well as in demand, is sesame paste. The recipe for sesame paste or, as it is also called, sesame paste (tahini) in the classic version contains only one component - these are sesame seeds, that is, the paste consists of 100% ground sesame seeds.

In this paste, the content of fatty acids of the ω-3 family, in particular, α-linolenic acid, is clearly insufficient, since sesame oil, and hence sesame, contains very little of this acid. Considering this circumstance, we proposed to obtain a paste from a mixture of sesame and flax seeds. In terms of oil content, flax seeds are very close to sesame seeds, and in terms of the content of α-linolenic acid, flax seeds are champions among oilseeds of plants.

To provide the required ratio of polyunsaturated fatty acids (PUFAs) of the ω-6 : ω-3 families, it is necessary to solve the system of equations:

$$\left.\frac{m_1 * c_1^{w_6} * M_1 + m_2 * c_2^{w_6} * M_2}{m_1 * c_1^{w_3} * M_1 + m_2 * c_2^{w_3} * M_2} = y\right\} \quad (1)$$

$$m_1 + m_2 = 1 \quad (2)$$

where, m_1 is the mass of sesame seeds, g or kg;
m_2 is the mass of flax seeds, g or kg;
$c_2^{w_6}$ is the content of linoleic acid in the oil of selected sesame seeds
seeds, %;
$c_1^{w_3}$ – content of α-linolenic acid in oil of selected
sesame seeds, %;
$c_2^{w_6}$ – the content of linoleic acid in the oil of selected linseed
seeds, %;

$c_2^{w_3}$ – content of α-linolenic acid in the oil of selected linseed seeds, %;

M_1 - oil content of selected sesame seeds, %

M_2 - oil content of selected linseeds, %

y - required ratio of PUFA families ω-6 : ω-3

For example, if it is necessary to obtain a paste from sesame and flax seeds with a ratio of ω-6 : ω-3 = 10, with the corresponding oil content of these seeds equal to 40% and 44%, respectively, with a content of linoleic acid (ω-6) in oils, respectively 40 % and 14%, and α-linolenic acid (ω-3) - 1% and 48%, respectively, the ratio of the mass of sesame and flax seeds should be 0.945: 0.055 (in grams or in kilograms). In wt.%, this ratio can be expressed as follows:

ground sesame seeds 94.5
ground flax seeds 5.5

Since the daily intake of flaxseeds is limited to 10-20 grams (no more) due to the biologically active linamarin glycoside they contain, taking into account the fact that for every 100 g of the resulting paste there are only 5.5 g ground flaxseeds, we can conclude that the resulting paste with a fortified functional property is completely food safe.[13-18]

You can make a three-component paste from sesame seeds, flax and sunflower seeds, given a known amount of sesame seeds, for example, m_1=0,8 (80%). In this case, the problem is solved using the following system of equations:

$$\left.\frac{m_1*c_1^{w_6}*M_1+m_2*c_2^{w_6}*M_2+m_3*c_3^{w_6}*M_3}{m_1*c_1^{w_3}*M_1+m_2*c_2^{w_3}*M_2+m_3*c_3^{w_3}*M_3}=y\right\} \quad (3)$$

$$m_1+m_2+m_3=1 \quad (4)$$

where,

m_1 – mass of crushed flaxseeds, g or kg;
m_2 – mass of crushed sunflower seeds, g or kg;
m_3 – mass of crushed sesame seeds, g or kg;
$c_1^{w_6}$– linoleic acid content in flaxseed oil, %;
$c_1^{w_3}$– α-linolenic acid content in flax seed oil, %;
$c_2^{w_6}$– linoleic acid content in sunflower seed oil, %;
$c_2^{w_3}$– content of α-linolenic acid in sunflower seed oil, %;
$c_3^{w_6}$– linoleic acid content in sesame seed oil, %;
$c_3^{w_3}$– content of α-linolenic acid in sesame seed oil, %;
M_1– oil content of crushed flaxseeds, %;
M_2– oil content of crushed sunflower seeds, %;
M_3– oil content of crushed sesame seeds, %;
y – required ratio of PUFA families ω-6 : ω-3

When the oil content of sunflower seeds is 52% and the content of linoleic acid in oil is 61%, and linolenic acid is 0.2% to ensure the required ratio of PUFA families ω-6 : ω-3=10 paste components are selected in the following calculated ratio:

Crushed mass of sesame seeds	80,0 %
Crushed mass of sunflower seeds	13,0 %
Ground mass of flax seeds	7,0 %

Kazakh researchers have developed and patented a method for producing sesame food paste [5] containing ground oil seeds - sesame and vegetable oil or a mixture of vegetable oils in the following ratio of components, wt.%:

crushed sesame seeds	60,0 - 85,0
vegetable oil	15,0 - 40,0

Here, if soybean, linseed or wheat germ oil, rich in ω-3 group PUFAs, is used as vegetable oil, then it is possible to somehow improve or balance the ratio of ω-6 and ω-3 PUFA groups in the paste. However, these oils are either difficult to extract (wheat germ oil) or rapidly oxidize on storage. [19-22]

Therefore, when using other vegetable oils, such as widely used sunflower or cottonseed oils, in order to balance the ratio of PUFAs ω-6 : ω-3, it can be recommended to include crushed non-fat flax seeds in the paste. So, when using in the composition of the paste 15-40% sunflower oil with a content of linoleic acid in the oil of 61% and linolenic acid -

0.2%, as well as crushed sesame and linseed seeds with an oil content and a content of fatty acids ω-6 and ω-3 indicated in the above examples, the problem is solved using the same systems of equations (3) and (4), where:

m_1 – mass of ground flaxseeds, g or kg;
m_2 – mass of ground sesame seeds, g or kg;
m_3 – weight of sunflower oil, g or kg;
$c_1^{w_6}$ – linoleic acid content in flaxseed oil, %;
$c_1^{w_3}$ – α-linolenic acid content in flax seed oil, %;
$c_2^{w_6}$ – linoleic acid content in sesame seed oil, %;
$c_2^{w_3}$ – content of α-linolenic acid in sesame seed oil, %;
$c_3^{w_6}$ – linoleic acid content in sunflower oil, %;
$c_3^{w_3}$ – content of α-linolenic acid in sunflower oil, %;
M_1 – oil content of crushed flaxseeds, %;
M_2 – oil content of crushed sesame seeds, %;
M_3 – oil content of sunflower oil, %;
y – required ratio of PUFA families ω-6 : ω-3

Thus, to ensure y=10 in the resulting paste, the ratio of components in wt.% will be as follows:
ground sesame seeds 76.2 - 45.8
ground flax seeds 8.8 - 14.1
sunflower oil 15.0 - 40.0

As can be seen, in such a paste, the content of ground flax seeds is somewhat higher, therefore, it is necessary to take appropriate measures to inactivate the enzymes that hydrolyze linamarin glycoside, for which heat treatment is recommended, which in this case is easily done by heating vegetable oil (up to 85-1050C) followed by mixing it with ground flax seeds.[23-27]
Thus, it is possible to obtain functional vegetable fat pastes balanced in composition (ratio) of ω-6 and ω-3 fatty acids.

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