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IMPROVING THE TECHNOLOGY OF SAUCES USING VEGETABLE AND BERRY RAW MATERIALS

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In developed areas, with the accelerated pace of life, the pressure of work is increasing, and the number of sub-healthy people is increasing. People begin to pay attention to health care. With the enhancement of people's awareness of health care and the pursuit of nutritious food, chia seeds have gradually become a hot spot in the field of food research.

Chia seeds have a long history of being edible, and they have been paid attention to and utilized in China in recent years. The active ingredients of chia seeds mainly include fatty acids, phenolic flavonoids, protein, dietary fiber, vitamins and minerals, which have anti-oxidation, blood lipid regulation, blood pressure regulation, blood sugar regulation, creatine kinase reduction, anti-inflammatory disinfection and other physiological functions effect.

In this study, cherries and purple cabbage were used to improve the sauce technology. Cherries and purple cabbage were used as the main raw materials, and chia seeds and other auxiliary materials were added to it, and the optimal formula of fruit and vegetable sauce was studied from the aspect of formula. By designing a single factor test and an orthogonal test, the comprehensive sensory evaluation of different raw and auxiliary materials on fruit and vegetable sauces was studied, and the best formula for making fruit and vegetable sauces was 160 grams of cherries, 110 grams of purple cabbage, 6 grams of chia seeds, 60 grams of 1.5 grams of white sugar, 1.5 grams of pectin, and 7 grams of lemon juice. The fruit and vegetable sauce produced by this formula has moderate sweetness and sourness, good color, unique flavor, good spreadability and good stability.

Among the main functional ingredients of the product, dietary fiber is the most abundant. Adequate intake of dietary fiber can reduce the postprandial blood sugar level of diabetic patients, and at the same time reduce the risk of postprandial hyperlipidemia, hyperinsulinemia and other chronic diseases.

The shelf life is very important for food manufacturers and consumers. This study uses the classic constant temperature accelerated test method, and according to the ALST test (shelf life test), the shelf life of the fruit and vegetable sauce is 300d.

Key words: *cherry, purple cabbage, chia seeds, fruit and vegetable sauce.*

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Introduction. At present, many countries in the world regard "functional food" as an important way and measure to solve social aging, prevent various adult diseases and reduce medical expenses.

Berries are rich in vitamins and minerals which can supplement the nutrients needed by the human body in time, promote human metabolism and energy metabolism, and are beneficial to health. The main nutritional value of vegetables is to provide the human body with a variety of vitamins, minerals and dietary fiber. Besides being rich in vitamins and minerals, it is also rich in various organic acids, aromatic substances and pigments.

Currently on the market, there are already products related to chia seeds. However, functional jams using it as a functional ingredient have not yet become popular in the market. Chia seed is a kind of health food with multiple health functions. It is a health food for longevity and has a certain preventive effect on high blood pressure and cancer. The potential market demand for its products is huge.

In this context, functional fruit and vegetable sauces added with chia seeds have broad development space and prospects, and also bring new development opportunities for functional foods.

At present, the research on jam is mainly focused on the research of jam technology and formula. In addition, the choice of thickener in the development of jam, the influence of different concentrations of temperature and ultra-high pressure treatment on the quality of jam, how to prevent browning during jam processing, It is also the main direction of its research.

In this study, fresh fruits and vegetables were used as raw materials, and sugar, acid, thickener and other auxiliary materials were added at the same time, and the gelatinous food was processed through a series of processes such as softening, peeling and concentration. At present, the research on it is mainly focused on the research on technology and formula.

Except adopting above-mentioned single kind of vegetable and fruit to develop jam, also have many to adopt multiple vegetables and fruit to carry out the development of compound jam. Tian Yu et al. (Tian Yu. et al, 2013) used single factor experiments, orthogonal experiments and response analysis experiments to analyze and study the key

factors affecting jams made of bananas, apples, hawthorns, and carrots. Geng Nan et al. (Geng Nan. et al, 2018) precooked hawthorn and red dates to soften them, determined the thickener according to the change of the gel strength value of the jam, and completed the development of hawthorn, red dates and jam through a combination of single factor and orthogonal experiments.This study uses cherries, purple cabbage and chia seeds as the main materials. Among them, cherries are very popular because of their sweet and sour taste. In addition to being used directly, they are often used to be processed into cherry jam. Purple cabbage and chia seeds are less studied when it comes to making sauces. The following lists some research experiments on them at home and abroad and some other researches on fruit and vegetable sauces.

Chu Weiyuan (Chu Weiyuan, 2002, p. 41-44) uses shiitake mushrooms, orange peels, and pumpkins as the main raw materials, through orthogonal experiments to scientifically optimize the formula, and adopts a new technology of vacuum concentration to develop a low-cost, high-efficiency soft canned shiitake mushroom fruit and vegetable sauce. Hou Lanfang, Li Yujie and others (Hou Lanfang, Li Yujie, 2019, p. 10-12+16) used hawthorn, carrot and bitter melon as raw materials to study low-sugar vegetable jam, and determined the best formula of jam through single factor test and orthogonal test.

The jam is bright in color and the sauce is fine and uniform, which can maintain the unique flavor of the fruit to a certain extent and is rich in nutrients, such as dietary fiber, calcium, potassium, zinc and other mineral elements. In addition, jam is also rich in pectin, which can prevent and reduce the absorption of lead and mercury in the intestine, and can be combined with lead in the gastrointestinal tract and excreted with feces, which has a very positive effect on controlling the level of lead in the human body. Pectin is also beneficial for gastrointestinal ulcers and other conditions, such as the gastrointestinal tract of infants and young children. In addition, with the enhancement of people's health awareness, in recent years, jams with health functions have been developed in large quantities, such as banana jam rich in dietary fiber, carrot jam, etc., which are very popular among consumers (Wei Ping, You Xiangrong, Zhang Yayuan, et al., 2016, p. 63-67).

Chia seeds are rich in essential fatty acid α-linolenic acid, a variety of antioxidant active ingredients (chlorogenic acid, caffeic acid, myricetin, quercetin, kaempferol, etc.), is a source of natural omega-3 fatty acids, and contains Rich in dietary fiber, protein, vitamins, minerals, etc. (Loreto A. Munoz et al., 2013, p. 394-408).

There are already examples of adding chia seeds as functional ingredients in food production on the market. This research hopes to develop a functional fruit and vegetable sauce, so by adding functional chia seeds to the fruit and vegetable sauce to achieve Purpose. The developed fruit and vegetable sauce is rich in dietary fiber and is suitable for dieters and people with chronic diseases.

Materials and Methods. Cherries comply with GB/T 26906-2011; purple cabbage complies with NY/T 746-2020; chia seeds comply with Q/MBBL 0005 S-2017. The same batch of fresh raw materials is used, and the brand, specification and manufacturer of each raw material are marked. Firstly, the optimal formula of fruit and vegetable sauce is determined through single factor test and orthogonal test, and then a series of experiments are carried out to determine the optimal formula. Determination of moisture content adopt the second method of GB 5009.3-2016 "Determination of Moisture in Food". Determination of reducing sugar of GB 5009.7-2016 "Determination of Reducing Sugar in Food" is adopted direct titration method. Determination of soluble solid content according to GB/T 10786-2006 "Testing methods for canned food", the refractometer method is used. Determination of acidity adopt the acid-base indicator titration method.

Results and Discussion. The production of functional fruit and vegetable sauce with berries and vegetables as main raw materials meets the new demands of people's diet. In addition, mixing gel substances with fruits, vegetables, sugar and acidity regulators to make fruit and vegetable sauces is a way to preserve fruits and vegetables for a long time. The natural fruit acid contained in it can promote the secretion of digestive juice, enhance appetite and help digestion. In addition, it can also increase pigment, which has an auxiliary effect on iron deficiency anemia.

The main materials of this study are cherries, purple cabbage and chia seeds, and the nutritional components of the three are shown in Table 1.

Table 1

Nutritional composition of cherries, purple cabbage and chia seeds

Project	Cherry	Purple cabbage	Chia seeds	
	Nutrient content (content in 100 grams of edible portion)			NRV%
Eenergy	194kJ	89kJ	1808kJ	22%
Protein	1.1g	1.1g	21.5g	36%
Fat	0.2g	0.3g	31.1g	52%
Carbohydrate	10.2g	3.7g	0g	0%
Dietary fiber	0.3g(Insoluble)	2.5g	36.5g	146%
Sodium	8mg	8mg	0mg	0%
Polyunsaturated fatty acids			19.3g	

Cherries comply with GB/T 26906-2011;

Purple cabbage complies with NY/T 746-2020;

Chia seeds comply with Q/MBBL 0005 S-2017

The nutritional value of cherries are: the iron content of cherries is particularly high, cherries are rich in nutrition, have the functions of regulating the middle and replenishing qi, invigorating the spleen and stomach, and dispelling rheumatism, people with indigestion, paralysis, rheumatism, waist and leg pain, weak constitution and dull complexion are suitable for consumption, cyanide acid in wild cherry exists in a large number of seeds and fruits (so this kind of fruit should not be eaten more).

A variety of purple cabbage in the genus Brassica oleracea. Cabbage originated from the European Mediterranean coast to the North Sea and has been cultivated for thousands of years.

Purple cabbage is known as the "poor man's doctor.» It is a high-quality anti-cancer vegetable, containing more water, rich in protein, fat, carbohydrates, dietary fiber, carotene, and various vitamins and minerals such as calcium, phosphorus, iron, potassium, sodium, chlorine, etc.

Chia seeds, originated in Mexico and Guatemala, angiosperms, dicotyledons, Lamiformes, Lamiaceae, Salvia genus, are the seeds of Chia sage. The edible history of chia seeds is very long. In recent years, as people's awareness of health care continues to increase, the demand for healthy and nutritious food continues to increase, and chia seeds have become a new hot spot.

Chia seeds contain a large amount of dietary fiber, crude protein, trace elements, and minerals, etc., and the ingredients are relatively complex. At present, there are many active ingredients that have been studied at home and abroad.

In order to explore the interrelationships among various factors, the most critical influencing factors and levels in the single factor experiment were taken to conduct an orthogonal experiment. Scoring criteria for the quality of fruit and vegetable sauces are shown in Table 2.

The factor levels are shown in Table 3.

The classical constant temperature accelerated test method was adopted. The determination of food shelf life is an important part of the food development process and food production system (Ren Yani, Che Zhenming, Jin Xuemin, et al., 2011, p. 156-158). While providing a reference for manufacturers to launch new products, it also ensures the safety and health of consumers.

According to the single factor test results of the recipe, it can be known that the addition of cherries, purple cabbage, chia seeds, and white sugar are the key factors affecting the sensory evaluation of fruit and vegetable sauces.

According to the results of the single factor test, the orthogonal table 10 is listed. The results of the orthogonal test are as follows shown in Table 4.

The results of the orthogonal test showed that the primary and secondary order of the influence of key ingredients on the sensory evaluation of fruit and vegetable sauces was cherry>purple cabbage>white sugar>chia seeds. From the perspective of sensory evaluation, the best formula for fruit

Table 2

Scoring criteria for the quality of fruit and vegetable sauces

Scoring items	Sensory Evaluation Criteria	Score
	Sweet and sour, delicate taste	20-30
Taste (30)	Sour or sweet, poor taste	10-19
	The ratio of sweet and sour is not harmonious, and the taste is rough	1-9
	The sauce body is uniform, the gel is good, no sugar or water is precipitated	20-30
Organization Status (30)	The sauce body is uniform, the gel is good, and a small amount of sugar and water are precipitated	10-19
	The sauce body is uneven, the gel is poor, and a lot of sugar and water are precipitated	1-9
	Blended scents harmonize and smell fresh	10-15
Aroma (15)	The mixed fragrance is unnatural and has a peculiar smell	5-9
	Poor mixed aroma and peculiar smell	1-4
	Deep reddish purple, the color of the sauce body is even and natural, shiny	10-15
Color (15)	It is reddish-purple, and the color of the sauce is more uniform and natural, with little luster.	5-9
	The color of the sauce body is uneven and natural, dull	1-4
	Easy to apply, the coating is coherent and even, without layering	8-10
Spreadability (10)	Easy to apply, the coating is more consistent but uneven	4-7
	Easier to apply, but the coating is incoherent, uneven, and prone to fracturing	1-3

Table 3

Formulation orthogonal test factor levels

Level	A	B	C	D
	Cherries/g	Purple cabbage/g	Chia seeds/g	Sugar/g
1	150	100	6	50
2	160	110	8	55
3	170	120	10	60

and vegetable sauce is 160 grams of cherries, 110 grams of purple cabbage, 6 grams of chia seeds, and 60 grams of sugar.

The measurement results of physical and chemical indicators are shown in Table 5.

For the fruit and vegetable sauce in this study, the total number of bacterial colonies is the key deterioration factor, and the classic constant temperature accelerated test method is used to test at constant temperatures of 36 °C and 46 °C. According to the shelf life test (ALST), $\theta(ST1) = \theta(ST2) \times Q10^{(T2 - T1)}$, calculate the shelf life of the fruit and vegetable sauce at room temperature (25 ℃) (Dong Wenshen, Qu Falin, Xu Bo., 2011, p. 87-88; Ge Wenhua, Wang Baowei, Hou Jie., 2013, p. 239-242). The final shelf life calculation result is 300d.

According to previous research, the product description can be summarized as the following Table 6.

Conclusion. At present, there are few functional fruit and vegetable jams on the market that are developed by adding vegetables to the jam, and its product development is still in its infancy. In this paper, the functional fruit and vegetable sauce produced with cherries, purple cabbage, chia seeds, etc. as the main raw materials meets people's new dietary needs. Due to its rich taste and flavor, it can be eaten with steaks, salads and breads. The research results are as follows:

The optimal formula of fruit and vegetable sauce was determined through single factor test and orthogonal test. The results showed that 160 grams of cherries, 110 grams of purple cabbage, 6 grams of chia seeds, 60 grams of white sugar, 1.5 grams of pectin, and 7 grams of lemon juice. The fruit and vegetable sauce produced by this formula has moderate sweetness and sourness, good color, unique flavor, good spreadability and good stability.

Table 4

Formulation Orthogonal Table L9 (34)

Test number	Factor				Test results
	A (cherry)	B (purple cabbage)	C (Chia seed)	D (sugar)	Sensory Score
1	1(150g)	1(100g)	1(6g)	1(50g)	79.79
2	1	2(110g)	2(8g)	2(55g)	77.44
3	1	3(120g)	3(10g)	3(60g)	76.96
4	2(160g)	1	2	3	80.46
5	2	2	3	1	82.71
6	2	3	1	2	77.13
7	3(170g)	1	3	2	68.86
8	3	2	1	3	75.32
9	3	3	2	1	69.25
K_1	234.19	229.11	232.24	231.75	
K_2	240.30	235.47	227.15	223.43	
K_3	213.43	223.34	228.53	232.74	
R	8.96	4.04	1.70	3.10	

Table 5

The measurement results of physical and chemical indicators

Physical and chemical indicators	Result
Moisture content	63.75%
Reducing sugar content	38.9g/100g
Soluble solid content	73%
Acidity	1.56%
Viscosity	3.72Pa.s

Table 6

Product Description

PRODUCT DESCRIPTION	
Product name	**Fruit and Vegetable Dressing with Chia Seeds**
Main Raw Materials	Chia seeds, purple cabbage, cherries, pectin, lemon juice, sugar
Important product characteristics	Rich in dietary fiber
Intended use and suitability for consumers (main consumers, distribution methods, etc.)	People with cardiovascular and cerebrovascular diseases or constipation Wholesale and retail
Edible method	Ready to eat
Type of packaging	Glass jar
Shelf life	300 days at room temperature

Among the main functional ingredients of the product, dietary fiber is the most abundant. Adequate intake of dietary fiber can reduce the postprandial blood sugar level of diabetic patients, and at the same time reduce the risk of postprandial hyperlipidemia, hyperinsulinemia and other chronic diseases.

The shelf life is very important for food manufacturers and consumers. This study uses the classic constant temperature accelerated test method, and according to the ALST test (shelf life test), the shelf life of the fruit and vegetable sauce is 300d.

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Удосконалення технології соусів з використання овочево-ягідної сировини

В даний час за рахунок зміни харчування людей, почастішали випадки хвороб населення різних вікових категорій. У розвинутих країнах, з прискореним темпом життя, навантаження на людину постійно зростає, що зумовлює інтенсифікацію процесів зниження здоров'я населення. Тому більшість людей починають звертати увагу на своє здоров'я та його підтримку. З підвищенням обізнаності людей про раціональне харчування та вплив його на здоров'я, насіння чіа поступово стає одною з інноваційних видів сировини в галузі харчових досліджень та розробки нових харчових продуктів функціонального призначення.

Насіння чіа давно вважаються їстівними, останніми роками воно набуло особливої популярності та знайшло широке використання у Китаї. Активні інгредієнти насіння чіа в основному включають жирні кислоти, фенольні флавоноїди, білок, харчові волокна, вітаміни та мінерали, які мають антиоксидантну дію, регулюють ліпіди в крові, артеріальний тиск, рівень цукру в крові, мають протизапальну дію та впливають на інші фізіологічні функції.

У даній роботі проводили удосконалення технології соусу з використанням вишні та червоноголової капусти. В якості основної сировини використовували вишню та червоноголову капусту, в соус додавали насіння чіа та інші допоміжні речовини, визначали оптимальне співвідношення основних рецептурних компонентів соусу. В роботі проведено комплексну сенсорну оцінку різних сировинних і допоміжних матеріалів у фруктово-овочевих соусах за допомогою однофакторного експерименту та встановлено, що фруктово-овочевий соус, отриманий за розробленою рецептурою, має помірну солодкість і кислинку, гарний колір, унікальний смак, в'язку структуру та добру стабільність.

У даному дослідженні було визначено термін зберігання соусу за допомогою класичного прискореного методу випробування при постійній температурі, і згідно з тестом ALST (тест терміну придатності). Встановлено, що термін придатності фруктово-овочевого соусу становить 300 днів.

Ключові слова: *вишня, червоноголова капуста, насіння чіа, фруктово-овочевий соус.*