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Development of Healthy Chips Fortified with Sesame and Pumpkin Seeds

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"And their last supplication is: Praise be to Allah, Lord of the Worlds."

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It was a long road full of failures and successes, and I am proud of my struggle to achieve my dreams.A moment I had always waited and dreamed of, in a story whose chapters have now come to an end.

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Dedication

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Abstract

This study investigated the formulation and development of functional baked potato chips enriched with ground sesame and pumpkin seeds, aiming to evaluate their effects on the chemical composition (moisture, fat, ash, and fiber), physicochemical properties, extent of oxidation, antioxidant activity, and sensory characteristics of the manufactured chips. Two formulations were prepared: chips containing 15g of sesame seeds (CS) and chips containing 15g of pumpkin seeds (CP). Commercial potato chips were used as the control (CC). The chemical composition was significantly influenced by the type of chip and the incorporation of sesame and pumpkin seeds. The CC sample exhibited the lowest moisture, ash, and fiber contents, and the highest fat content. At the same time, the proximate composition of CS and CP was characterized by low fat content and high moisture, ash, and fiber levels. In terms of pH, no significant difference was detected between all samples. The CC sample had the lowest peroxide value, followed by the CP sample, then the CS one.A significant difference was detected between the control sample and the seed-incorporated samples, which had the lowest acidity value.Regarding antioxidant activity (DPPH), the CS and CP samples showed higher activitythan the control. Sensory scores were affected by sesame and pumpkin seeds; the CC sample had the highest average across all the sensory attributes tested compared to the added seeds samples.

Keywords: Functional Snacks, Potato Chips Fortification, Sesame and Pumpkin Seeds, Antioxidant Activity, Physicochemical and Sensory Analysis.

Résumé

Cette étude a porté sur la formulation et le développement de chips de pomme de terre cuites au four à valeur fonctionnelle, enrichies en graines de sésame et de courge moulues. L'objectif était d'évaluer leurs effets sur la composition chimique (humidité, matières grasses, cendres et fibres), les propriétés physico-chimiques, le degré d'oxydation, l'activité antioxydante et les caractéristiques sensorielles des chips produites. Deux formulations ont été développées : des chips contenant 15 g de graines de sésame (CS) et des chips contenant 15 g de graines de courge (CP). Des chips de pomme de terre commerciales ont servi de témoin (CC).La composition chimique a été significativement influencée par le type de chips et l'incorporation des graines. L'échantillon CC présentait les plus faibles teneurs en humidité, cendres et fibres, mais la plus forte teneur en matières grasses. À l'inverse, les échantillons CS et CP étaient caractérisés par une faible teneur en matières grasses et des niveaux élevés d'humidité, de cendres et de fibres. Aucun écart significatif n'a été observé entre les échantillons en ce qui concerne le pH. La valeur du peroxyde la plus faible a été relevée dans l'échantillon CC, suivi par CP, puis CS. Une différence significative a été observée entre l'échantillon témoin et ceux enrichis en graines, ces derniers présentant une acidité plus faible.Concernant l'activité antioxydante (DPPH), les échantillons CS et CP ont montré une activité supérieure à celle du témoin. Enfin, les scores sensoriels ont été influencés par l'ajout de graines : l'échantillon CC a obtenu la meilleure moyenne pour l'ensemble des attributs sensoriels évalués, comparativement aux échantillons enrichis.

Mots-clés : Snacks fonctionnels, Fortification des chips de pommes de terre, Graines de sésame et de courge, Activité antioxydante, Analyse physico-chimique et sensorielle.

الملخص

هدفت هذه الدراسة إلى تطوير رقائق بطاطا مخبوزة وظيفية مدعّمة ببذور السمسم واليقطين المطحونة، من خلال تقييم تأثيرها على التركيب الكيميائي (الرطوبة، الدهون، الرماد، والألياف)، والخصائص الفيزيائية والكيميائية، ومستوى الأكسدة، والنشاط المضاد للأكسدة، والخصائص الحسية للرقائق المنتجة .تم تحضير تركيبتيْن :رقائق تحتوي على 15 غراماً من بذور السمسم (CS)وأخرى تحتوي على 15غراماً من بذور اليقطين (CP)، بينما استُخدمت رقائق بطاطا تجارية كعينة ضابطة (CC)أثّر نوع الرقائق وإدماج البذور بشكل ملحوظ على التركيب الكيميائي؛ حيث أظهرت العينة الضابطة (CC)أقل محتوى من الرطوبة والرماد والألياف، وأعلى نسبة دهون .في المقابل، تميزت رقائقCSوCPبانخفاض نسبة الدهون وارتفاع نسب الرطوبة والرماد والألياف .لم تُسجل فروق معنوية في قيم الأس الهيدروجيني (pH)بين العينات .كانت أدنى قيمة لبيرو كسيد الدهون في العينة الضابطة، تليها CPثم CSكما لوحظ فرق معنوي في الحموضة، حيث كانت أقل في العينات المدعّمة بالبذور مقارنة بالعينة الضابطة.أما بالنسبة للنشاط المضاد للأكسدة (DPPH)، فقد سجلت العينات CSو CPنشاطاً أعلى من العينة الضابطة .وعلى الصعيد الحسي، تأثرت التقييمات بإضافة البذور، حيث حصلت العينة الضابطة على أعلى متوسط في مختلف الصفات الحسية مقارنةً بالعَيّنات الأخرى.

الكلمات المفتاحية: الوجبات الخفيفة الوظيفية، تدعيم رقائق البطاطا، بذور السمسم واليقطين، النشاط المضاد للأكسدة، التحليل الفيزيائي-الكيميائي والحسي.

List of Abbreviations

Abbreviation	Stands for
°C	Degree Celsius
%	Percent
AOAC	Association of Official Analytical Chemists
AGEs	Advanced glycation end products
AW	Water Activity
DMF	Dry Masa Fresh
DPPH	Diphenyl-1-picrylhydrazyl.
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization
HMF	Hydroxymethyl furfural
HOSO	High-oleic sunflower oil
H2SO4	Sulfuric acid
ISO	International Organization for Standardization
KCAL	kilocalorie
KOH	Potassium Hydroxide
LDL	Low-density lipoprotein
M	Molar
meq/kg	milliequivalents per kilogram
min	minutes
mg/g	Milligram per gram
mg/ml	Milligrams per milliliter
N	Normality
NaOH	Sodium hydroxide
nm	Nanometer
pH	Potential of Hydrogen
PV	Peroxide value
WHO	World Health Organization

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INTRODUCTION

Introduction

A snack is typically defined as a food item consumed between main meals, often characterized by high energy density and low nutritional value. Among these, potato chips are the most widely consumed snack globally (Ali *et al*., 2019). However, their nutritional composition is notably imbalanced;they are generally low in sugars and proteins, high in saturated fats, and deficient in carbohydrates and dietary fiber. Consequently, they contribute a substantial number of calories, primarily from fats, which are considered empty calories due to their minimal nutritional benefit (Fariha, 2019). The consumption of such nutritionally poor products has been directly associated with adverse health outcomes, including cardiovascular diseases, obesity, and type II diabetes (López-Martínez *et al*., 2019; Aydin, 2022).

For such reasons, improvements in food science and technology facilitate the production of functional foods. In this context, healthy, natural, and appropriate snack foods are a trend in the world market. Thus, it is required to have new sources of functional characteristics, which can help meet rising consumer demand for healthier food (Aydin, 2022).

Incorporating pumpkin seeds into chip formulations offers a viable approach to producing healthier snack options by enhancing their nutritional profile. Pumpkin seeds are rich in polyunsaturated fatty acids, essential vitamins, antioxidants, and various micronutrients. They also provide significant amounts of potassium, phosphorus, and magnesium, along with moderate levels of other trace minerals. These nutritional attributes position pumpkin seeds as a valuable functional ingredient in the development of fortified snack products (Fariha, 2019).

Also,Sesame has a high potential to be used as an ingredient in the food industry because it increases the nutritional value of foods (Mustafa and Hüseyin, 2023) sinceitis a significant source of protein and oils, with high concentrations of carbohydrates and essential dietary fibers (Haque*et al*., 2025).In addition to this, sesame has three times more calcium compared with an equivalent quantity of milk (Abbas*et al*., 2022).

Furthermore, scientific studies have demonstrated the various health effects of sesame seeds, including anticancer and antioxidation properties. Notably, sesame has the potential to address malnutrition and food security issues in both underdeveloped and developed countries due to its nutritious properties. Given these remarkable properties, there is a growing interest in the use of sesame and its products in the food industry and nutraceutical applications (Haque *et al*., 2025)

This research aims to develop a formulation of functional healthy baked potato chips fortified with whole ground sesame and pumpkin seeds and to investigate the effect of sesame and pumpkin seeds on the physicochemical composition, nutritional, and sensorial acceptability.

CHAPTER 01
LITERATURE REVIEW

1.1. Definition of Snacks

Snacks are defined as foods consumed between main meals, characterized by their small size, whether as quick or casual bites. These snacks are often ready-to-eat, rich in oils, and seasoned with salt or salty flavors, with a growing popularity of sweet options made from fruits and vegetables. What distinguishes snacks is their long shelf life at room temperature, which is attributed to various drying methods, such as frying, roasting, baking, or salting. Their packaging also plays a crucial role in maintaining freshness and preventing moisture absorption and oil rancidity (Hocine and Si Ammour, 2024).

Snacks encompass a diverse range of foods, including vegetable chips, dried fruits, yogurt, and nuts. They are distinguished by their convenience and accessibility, making them a popular choice for satisfying hunger or a quick bite. However, there is no standard definition of snacks, which creates difficulties in nutritional studies and health interventions[1].

Snack definitions are influenced by several factors, including:

- **Food types:** This includes foods that are considered snacks, such as fruits, vegetables, nuts, and dairy products.
- **Portion size:** This refers to the amount of food that is served as a snack, which is usually smaller than a main meal.
- **Time:** This includes the time of day when a snack is eaten and its relationship to main meals, as well as the time it takes to prepare or eat it.
- **Location:** This refers to the place where a snack is served, whether inside or outside the home.
- **Purpose:** This is the goal of a snack, such as relieving hunger or preventing it until the next meal(Hess*et al.*, 2016).

1.2.Types of Snacks

Snacks come in a wide variety, and can be categorized into several types, including:

- **Healthy snacks:** These include fruits, vegetables, nuts, seeds, yogurt, low-fat cheese, and whole grains.
- **Unhealthy snacks:** These include processed foods, fast food, sweets, sugary drinks, chips,and sweetened juices.
- **Traditional snacks:** These include foods that are popular in a particular culture, such as pastries, pies, and roasted nuts(Hess *et al.*, 2016).

1.3.Definition of Chips

Chips, as defined by the Larousse dictionary, are thin slices of potatoes that are fried, also known as "potato chips." The word originates from English, "chip," meaning "splinter" or "wood shaving," and is rarely used in the singular form due to the difficulty of stopping at just one slice. Chips are thin slices of potatoes, and sometimes vegetables or fruits that are fried in oil, salted, and seasoned, resulting in a crispy and delicious snack. Food companies produce various types and flavors of chips to increase their popularity as a snack. Currently, skilled chefs use chips as a sophisticated side dish in high-end restaurants(Haidra, 2023).

1.4.History of Chips

One of the most famous stories regarding the invention of potato chips attributes their creation to George Crum, an African American chef working at Moon's Lake House in Saratoga Springs, New York, in 1853. The restaurant began serving thin and crispy potatoes regularly, naming them "Saratoga Chips." Over time, the concept spread across the United States and eventually the world [2].

Historical records suggest that thinly sliced, fried potatoes existed before 1853.In 1822, British doctor and culinary writer William Kitchiner published a cookbook titled "The Cook's Oracle." The book contained a recipe instructing readers to slice potatoes thinly and fry them until they became golden and crispy.This suggests that the idea ofthin, crispy potato slices was not exclusive to Crum's discovery and had already been documented 31 years earlier [3].

Another theory suggests that potato chips originated in Belgium long before they appeared in the United States or England.In the city of Namur,Belgium, people traditionally celebrated an annual festival where fried river fish was a staple dish. However, in 1781, whenthe river frozeover and fish became scarce, chefs sought an alternative. To replicate the texture and crispiness of fried fish, they thinly sliced potatoes, fried them, andseasoned them with salt. This method produced a result remarkably similar to modern potato chips, suggesting that the snack might have had European roots before itsformal introduction in America[4].

1.4.1Evolution of the PotatoChips Industry throughout History

In 1860, George Crum opened hisrestaurant to make the "Saratoga Chip" a popular snack, and he continued to innovate in the culinary world. By 1895, William Tappenden of Cleveland, Ohio, began selling potato chips as a food product in grocery stores, helping to popularize them further. In 1908, the Leominster Potato Chip Company was established in Leominster, Massachusetts, later becoming known as "Tri-Sum"[5].

The industry continued to grow, and in 1910, Mikesell's Potato Chips was founded in Dayton, Ohio, becoming one of the first companies dedicated to producing potato chips. By 1921, new companies emerged, including Wise Delicatessen in Berwick, Pennsylvania, and Utz in Hanover, which introduced potato chips under the "Hanover Home Brand".In 1926, Scudder's was founded in Monterey Park, California, adding more variety to the expanding potato chip market. Then, in 1932, Herman Lay established Lay's in Nashville, Tennessee, a brand that would go on to become one of the most well-known names in the industry[5].

1.5.Types of Chips

1.5.1.Plain Potato Chips

Plain potato chips are the most basic variety, containing only salt as a seasoning. These chips are typically thin, crisp, and light in texture. Their flavor is primarily derived from the natural taste of fried potatoes, and their quality varies depending on factors such as oil type, frying method, and seasoning balance. Some plain chips have a mild or neutral flavor, while others may exhibit an oily or stale aftertaste [6].

1.5.2Kettle-Style Potato Chips

The potatoes are sliced and then placed in a pot of hot oil. After that, they are taken out and left to drain before repeating the process. Each time a new batch of potato slices is added, the oil temperature drops, leading to a longer cooking time. The longer the cooking time, the more the starch in the potatoes breaks down, resulting in thicker and crunchier chips[7].

1.5.3.Wavy and Rippled Potato Chips

Wavy and rippled potato chips are characterized by their textured surface, which makes them thicker than regular potato chips and particularly suitable for dipping. Their wide ridges allow them to hold sauces effectively while providing a satisfying crunch and a well-balanced potato flavor. Despite their increased thickness, they maintain a light and enjoyable texture. However, some consumers may find their salt content relatively high, especially with continuous consumption[6].

1.5.4.Tortilla Chips

The production of tortilla chips involves several stages, starting with coarsely ground masa, which can be either fresh or reconstitutedfrom dry masa fresh (DMF). The masa is laminated and cut into various shapes, such as triangles, small circles, or strips, in preparation for subsequent processing steps, including baking, cooling, deep frying, and seasoning. On the other hand, restaurant-style tortilla chips are typically made from fine masa, which is sheeted into thin tortillas and then cut into four pieces before frying (Serna-Saldivar,2022).

1.5.5.Extruded Corn Chips

Extruded corn chips are produced using coarsely ground masa, which can be either fresh or reconstituted from DMF. The manufacturing process involves extruding the dough to achieve the desired shapes before cutting it into individual chips. These chips then undergo deep frying, followed by salting or seasoning to enhance their flavor. The primary stages of production include dough extrusion, shaping, and subsequent frying to achieve the final product (Serna-Saldivar,2022).

1.5.6.Pita Chips

Pita bread and pita chips offer a healthier alternative to commercially processed snacks, as they are free from preservatives and artificial additives. The preparation of pita bread involves combining flour, yeast, water, and salt to form a dough, which is then baked at high temperatures until it puffs up. To create pita chips, the bread is sliced into wedges, coated with a mixture of olive oil and seasonings, and baked until crisp, resulting in a nutritious and flavorful snack(Ivankoand Kivirist, 2011).

1.5.7.Plantain Chips

Plantains are a fruit that is cooked like a vegetable. They look similar to bananas but are quite different. When unripe, they have a starchy taste similar to potatoes, but as they ripen, their flavor becomes sweeter, resembling sweet potatoes. Depending on their ripeness, they can be green, yellow, or speckled/brown [8].

1.5.8.Pringles Chips

Pringles are cleverly engineered to be stackable, slim, and packaged in a durable container that minimizes breakage. Their uniform shape is achieved through a specialized formula that does not include whole potatoes. Instead, they are made from "dehydrated processed potato" along with other ingredients such as corn, rice, and wheat.This is why Pringles aren’t potato chips[9].

1.6.Technological Quality of Chips

1.6.1.Ingredients and Raw Materials

- **Type of Potatoes:** Low-sugar varieties are preferred to prevent excessive browning during frying (Lisinskaand Leszczynski,1989).
- **Oils Used:** High-quality oils such as sunflower or palm oil improve flavor and reduce health risks (Lusas and Rooney, 2001).
- **Additives:** Flavor enhancers and preservatives should be safe and within recommended limits (FAO, 2020).

1.6.2.Production Process

- **Uniform Slicing:** Ensures even cooking and prevents overcooked or undercooked portions (Pedreschi*et al*., 2006).
- **Frying Temperature:** Proper temperature control prevents the formation of harmful compounds like acrylamide (Friedman, 2003).
- **Filtering and Drying:** Help remove excess oil andensure optimal crispiness (Fillion and Henry, 1998).

1.6.3.Packaging and Storage

- **Sealed Packaging:** Prevents moisture absorption and maintains crispiness (Mestdagh*et al*., 2008).

- **Use of Inert Gases (Nitrogen):** Reduces oxidation and extends shelf life (Guy, 2001).
- **Storage Conditions:** Should be dry and away from heat to prevent rancidity and loss of texture (Grob, 2018).

1.7.Biochemical Quality of Chips

1.7.1LipidOxidation

- **Type of Frying Oil:**The stability of the frying oil significantly affects the rate of lipid oxidation. Potato chips fried in oils with higher oxidative stability, such as high-oleic sunflower oil (HOSO), exhibit reduced oxidation rates compared to those fried in conventional sunflower oil (Marasca*et al*., 2016).
- **Storage Conditions:**Elevatedstorage temperatures accelerate lipid oxidation. For instance, potato chips stored at 45°C showed increased peroxide values, indicating higher oxidation levels (Labuza and Bergquist, 1983).Flushingpotato chips with nitrogen gas before sealing can slow down oxidation by displacing oxygen, thereby enhancing shelf life (Marasca*et al*., 2016).
- **Water Activity (Aw):** Lipid oxidation rates in potato chips are influenced by their water activity. Studies have shown that oxidation rates decrease as water activity increases from 0.01 to 0.4 (Quastand Karel, 1972).
- **Indicators of Lipid Oxidation:**Peroxide Value (PV) Measures the concentration of peroxides and hydroperoxides formed during the initial stages of lipid oxidation. An increase in PV indicates progression in oxidation (Labuza and Bergquist, 1983). Also, the presence of volatile compounds, such as hexanal, serves as an indicator of lipid oxidation. Their concentration correlates with the extent of oxidation (Min and Schweizer, 1983).

1.7.2.Maillard Reaction

The Maillard reaction plays a crucial role in developing the sensory characteristics of potato chips, particularly their golden color and distinctive flavor. However, this reaction can also lead to the formation of potentially harmful compounds, such as acrylamide and 5-hydroxymethylfurfural (HMF). Food composition and processing techniques influence the Maillard reaction and the sensory quality of fried products. WhileMaillard reaction products can enhance the sensory quality of fried foods, they can also produce advanced glycation end products (AGEs), which negatively affect intestinal homeostasis. Innovative processing methods are needed to optimize the sensory properties of fried foods while minimizing the formation of AGEs (Shi *et al*., 2024).

Comparing the effects of air frying and traditional frying on the formation of Maillard reaction compounds in French fries. Air frying reduced the formation of acrylamide and HMF compared to traditional frying. Additionally, air frying increased the proportion of slowly digestible starch and reduced the resistant starch content, which could contribute to a more balanced glycemic response after consumption(Dong *et al*., 2022).

The formation of acrylamide in foods depends on several factors, including cooking temperature, water content, and the composition of carbohydrates and proteins in the products. This compound is primarily formed during the Maillard reaction, which occurs between asparagine, a naturally occurring amino acid, and reducing sugars such as glucose or fructose when foods are exposed to high temperatures (above 120°C) and low humidity. Starch-rich products, such as potato chips and French fries, are particularly affected by this formation. Studies have shown that acrylamide is genotoxic and carcinogenic in animals and may increase the risk of cancer in humans(EFSA, 2015).

1.8.Nutritional Quality of Chips

1.8.1.Macronutrient Composition

- **Carbohydrates:** A primary energy source, mainly in the form of starch;
- **Fats:** High-fat content due to frying, ranging from 30.29% to 42.98%;
- **Proteins:** Relatively low protein content, varying between 1.31% and 6.11% (Benkhoud*etal*., 2022).

1.8.2.Caloric Density

The combination of fats and carbohydrates makes potato chips calorie-dense, with an energy value between 555.1 and 618.14 kcal per 100 grams (Benkhoud*et al*., 2022).

1.8.3.Micronutrients and Minerals

Despite nutrient loss during processing, potato chips still provide essential minerals such as potassium, phosphorus, and magnesium (Gaytancıoğlu*et al*., 2024).

1.8.4.Fatty Acid Composition

The type of frying oil determines the fatty acid profile, influencing the balance between saturated and unsaturated fats and their health effects (Gaytancıoğlu*et al*., 2024).

1.8.5.Potential Harmful Compounds

High-temperature frying can lead to the formation of acrylamide, a compound linked to potential health risks, including cancer [11].

1.9.Health Issues Associated with the Consumption of Chips

1.9.1.Obesity

Potato chips are a rich source of calories due to their high fat content, averaging 25.8%. Regular and excessive consumption of these chips leads to an increase in calorie intake compared to calories burned, resulting in weight gain. Over time, this weight gain may develop into obesity, which in turn increases the risk of chronic diseases such as type 2 diabetes, cardiovascular diseases, and certain types of cancer (Haidra, 2023).

Additionally, potato chips contain saturated fats at an average of 3%, which are harmful fats that contribute to elevated levels of total cholesterol and LDL cholesterol in the blood. This chronic elevation in cholesterol increases the likelihood of heart attacks and strokes [12].

1.9.2.Diabetes

Fried foods are known to contain harmful compounds called advanced glycation end products (AGEs). Researchers found that taking just three servings of French fries per week was associated with an almost 20% increased risk of type 2 diabetes, whereas the risk associated with potatoes in general, including fries, was very slight[13].

1.9.3.Cardiovascular Diseases

High blood pressure poses a significant risk to cardiovascular health, potentially leading to stroke and kidney failure. Among the contributing factors, a diet rich in salt is a leading modifiable element. With changing lifestyles and globalization, the consumption of processed foods and salty snacks, such as potato chips, has increased, which are considered a major source of sodium in the modern diet. Given that potato chips contain high amounts of salt and sodium, their regular consumption increases the risk of cardiovascular diseases[14].

Additionally, potato chips contain saturated fats, which contribute to raising the level of bad cholesterol in the blood.Elevated bad cholesterol increases the risk of coronary heart disease. In summary, excessive consumption of potato chips can lead to serious cardiovascular health problems [15].

1.9.4.Metabolic Syndrome

The relationship between metabolic syndrome and potato chips lies in the fact that excessive consumption of potato chips can increase the risk of developing major factors that contribute to the development of metabolic syndrome.Due to their high content of calories and unhealthy fats, such as saturated and trans fats,regular consumption of potato chips poses a health risk. It can lead to weight gain and obesity, in addition to the accumulation of fat in the abdominal area, which is a primaryindicator of metabolic syndrome (Eckel*et al.*, 2005).

A systematic review has demonstrated a strong association between elevated sodium levels and an increased risk of metabolic syndrome, highlighting the need for further research to confirm this causal link. Given that potato chips typically contain significantamounts of sodium, excessive consumption of them can contribute to high blood pressure, which is itself a key component of metabolic syndrome (Soltani *et al*., 2019).

Some studies suggest that diets heavily reliant on processed foods, including snackslike potato chips, may lead to an increased risk of insulin resistance and thedevelopment of type 2 diabetes (Du *et al.*, 2024).

1.10.The Consumption of Potato Chips in Algerian Society

The consumption of potato chips in Algerian society varies depending on motivationsand age groups, reflecting different eating behaviors among individuals. Chips are no longer seen as just a food product, but rather as something with multiple dimensions: entertainment, taste, and social habits that differ from one consumer group to another(Chikhiand Berrouiguet, 2023).

1.10.1.Adults

Adults, especially those who are married, tend to consume potato chips moderately. In many cases, they purchase them primarily for their children rather than for themselves.This group shows a relatively higher level of nutritional awareness, as some associatechips with potential health risks such as high fat content and cholesterol. Therefore,their consumption of chips is not solely for pleasure but also stems from a functionalpurpose within family responsibilities, giving the product a more social role than merely satisfying a craving(Chikhi and Berrouiguet, 2023).

1.10.2.Teenagers

Teenagers and young adults (aged between 18 and 29) are among the most frequentandconsistent consumers of potato chips. They typically view chips as a source ofentertainment, especially while watching TV or during moments of boredom, and pay little attention to the nutritional value. What attracts them most is the taste and the instantpleasure they get, making them loyal customers of such products(Chikhi and Berrouiguet, 2023).

1.10.3.Children

Although children were not directly surveyed, the data shows that many young andadult respondents often buy chips for their children or younger family members, such as nieces and nephews. This makes children an indirect yet significant consumergroup. Chips are seen as a product that brings them joy and are often offered as a treat or reward, reinforcing the role of chips in family-centered consumption habits(Chikhi and Berrouiguet, 2023).

CHAPTER 02
MATERIAL AND METHODS

2.1. Healthy Chips Preparation

The healthy chips were produced using whole ground sesame seeds forChips with Sesame Seeds (CS) and whole ground pumpkin seeds for Chips with Pumpkin Seeds (CP), with 15.0 g of each type of seed. The other ingredients were kept constant in each produced chip formulation, containing 60 g of potato paste, 1 g of salt, and 5 gof water,as shownin Table 1.All ingredients were sourced from a local market. The control sample—salt-flavored potato chips (CC)—was obtained separately from a different retail outlet and originated from a single production batch.

Table 1: Formulation of functional potato chips

Ingredients (g)	**Samples**	
	CP	**CS**
Potato paste	60	60
Whole ground sesame seeds	-	15
Whole ground pumpkin seeds	15	-
Sodium chloride	1	1
Water	5	5

CP: Chips with pumpkin seeds; CS: Chips with sesame seeds.

The manufacturing procedure was done according to(Mostafa*et al.*, 2024) with slight modifications. Potatoes were boiled in water until they looked tender, then peeled and mixed until they reached a paste form with an electric mixer. The salt and flavoring were added to the same mixer. The whole seeds were cleaned by sorting to remove extraneous materials, milled, and sieved. The milled seeds of sesame and pumpkin seeds were added as shown in Table 1, and finally, water was added gradually until a dough was formed. Then it was formed to create the chip shapes with a forming tool. The chips were baked in the oven at 180 °C for 10 minutes (Figure 1). The two samples were packed in closed polyethylene bags at room temperatureuntil the analysis.

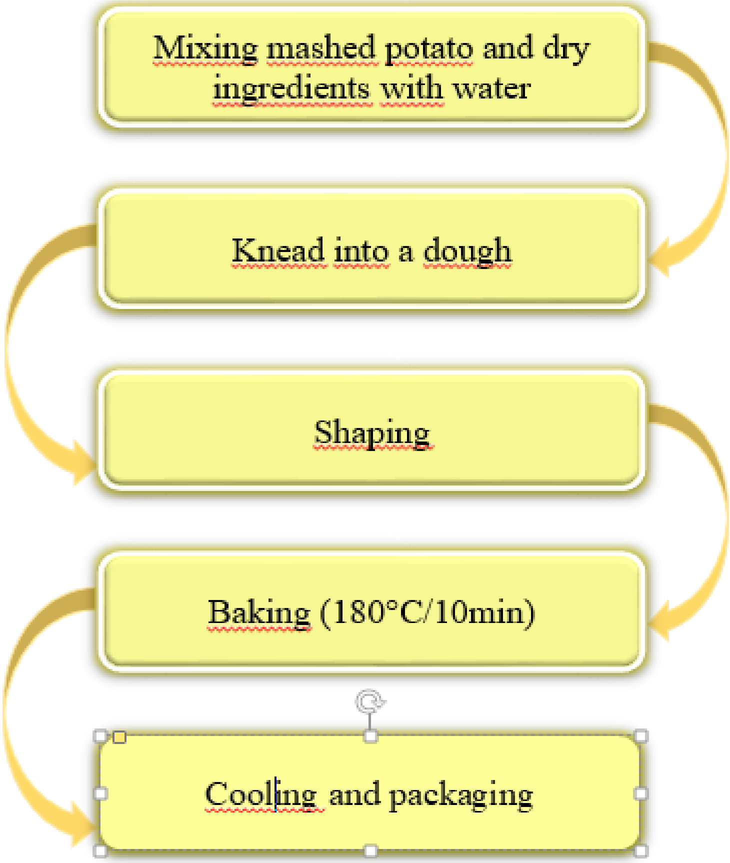

Figure 1: Schematic Presentation of the Manufacturing of Healthy Chips

2.2.Proximate Analysis

Two replicates were made for each sample for the following tests: Moisture, fat, ash, and fiber.

2.2.1.Moisture Content and Dry Matter

According to AOAC (2012), the oven drying method determined moisture content, where 10 grams of all the samples were heated in an air oven for 6 hours at 102°C. Moisture percent was calculated using the following equation:

$$\text{Moisture\%} = (\text{Loss in weight/Sample weight}) \times 100$$

2.2.2.Fat Extraction

Crude fats of control chips, chips with pumpkin seeds, and chips with sesame seeds were obtained according to the AOAC (2012) Soxhlet method. Soxhlet glassware was fitted to a weighed distillation flask containing diethyl ether solvent and placed in the apparatus's heater.The solvent was continuously volatilized and then condensed into the condenser apparatus to pass through the 10 g moisture-free ground sample placed into the filter paper and then into the extraction thimble.

After extraction, heating was stopped, the solvent was collected in the condenser apparatus and removed, and the crude fat left in the distillation flask was allowed to cool down and weighed. Fat% was calculated using the following equation:

Fat% = (weight of the fat in the sample/weight of dried sample)×100

2.2.3.Determination of Ash

The dry ashing method determined the samples' Ash content (AOAC, 2012). Five grams of the food samples were put in a weighed crucible and placed in a muffle furnace (Carbolite CWF 1100) at 600°C for 5 to 6 hours until they became completely free from carbon (i.e., a light gray or white color ash). Then, the crucible (with its content) was cooled in a desiccator at room temperature and weighed. Ash contents were calculated as follows:

Ash% = (Weight gain by the dish /Weight of the sample) ×100

2.2.4.Determination of Crude Fiber

The technique used was described by AOAC (1996). Two grams of the CC, CS, and CP sampleswere accurately weighed. The samples were separately boiled in 0.128 M of H_2SO_4 for 30 min. The acid boils, and the sampleswere digested in acid. After 30 minutes, the samples were washed with distilled water until the residueswere made acid-free.The acid-digested residueswere then subjected to alkali digestion; for this,0.128 M of NaOH was used. The acid-digested residueswere transferred to the boiling alkali for 30 min.After that,the samples were washed with distilled water until the residues were made alkali-free. The three residues were weighed, then dried in an air oven for 2 hours at 230°C. After that, the samples were weighed and placed in a muffle furnace at 550°C for 2 hours.

The crude fiber content was estimated according to the following expression:

$$Crude\ fiber\% = \frac{weight\ of\ the\ digested\ sample\ - weight\ of\ the\ ash}{weight\ of\ the\ sample} \times 100$$

2.3.Physico-chemical Analysis

2.3.1.pH Determination

The pH of the samples was determined according to Al Assoly et al. (2019) by blending 10 g of each sample with 100 mL of distilled water (1:10) and homogenizing for 2 minutes. The pH of the homogenate was then measured in triplicate using a pH meter.

2.4.Determination of chemical properties of extracted oils

2.4.1.Determination of Peroxide Value

Peroxide value (PV) was assessed using the standard AOAC method (AOAC, 2000). 20 ml of acetic acid and chloroform were added to 10g of the previously extracted oil until dissolution. After that, 0.5 ml of saturated potassium iodide solution was added and kept for exactly one minute. Then,60 ml of distilled water was added. Afterwards, 0.5 ml of 1% starch solution was added and titrated with 0.01 N sodium thiosulfate until the blue colour disappeared. The same steps were followed in a blank sample.

The peroxide value was estimated according to the following expression:

$$PV\ meq/KG = \frac{Sample\ titrant\ volume\ - blank\ titrant\ volume}{weight\ of\ the\ sample} \times 10$$

2.4.2.Determination of AcidityValue

Acidity was assessed according to ISO (2020). Ten grams of the oil extracted from the three samples was weighed. Neutralized alcohol (96°) was added to the samples' oil, then some drops of phenolphthalein were added to the samples, which were titrated with 0.35 N NaOH for the CP and the CS samples and 0.035 N NaOH for the CC sample.

The acidity was estimated according to the following expression:

$$Acidity\% = \frac{Titrant\ volume \times NaOH\ Normality \times molar\ mass\ of\ oleic\ acid\ (28.2)}{weight\ of\ the\ sample}$$

2.5.DPPH Radical Scavenging Activity

Antioxidant activity will be performed according to the method described by Esposito et al. (2005) and Al-Ismail et al. (2006) with some modifications. One gram of sample was suspended in 10 ml of 80% methanol in water and mixed for 45 minutes, then the stock solution was kept for 24h at 4°C. Different concentrations were made from the stock solution (0.2, 0.4, 0.6, 0.8, 1, 1.2 mg/ml). After that, the concentration samples were centrifuged at 4000 g for 10 minutes. 0.2 ml of Diphenyl-1-picrylhydrazyl (DPPH) (10 mg/100 ml 80% methanol) was mixed with 100 microlitresof supernatant. Mixtures were mixed thoroughly and were kept to stand for45 minutes in a dark place at room temperature. Against a control,the absorbance was measured at 519 nm using a spectrophotometer. TheDPPH scavenging activity was carried out in duplicate.

The radical scavenging activityof each extract will be expressed as a percent of inhibition according to the followingequation:

$$Inhibition\% = \frac{absorbance\ of\ the\ blank - absorbance\ of\ the\ sample}{absorbance\ of\ the\ blank} \times 100$$

2.6.Sensory Evaluation

Sensory evaluation was conducted by 32 non-trained panelists, including undergraduate and master's students, of the Faculty of Nature and Life Sciences, Earth and Universe Sciencesat the University of Guelma. The panelists were of both sexes and different ages. The three samples were placed on plastic plates and served to panelists who evaluated desirability for color, flavor, texture, odor, and overall liking using a 9-point hedonic scale described by Larmond (1991) (Annex). Each sample was coded with a randomly selected three-digit number. Pieces of plain biscuits and water were used to neutralize the taste between samples.

2.7.Statistical Analysis

To meet the objective of this study, a statistical analysis was carried out using Excel software (Microsoft Office, 2013). The data was prepared and imported into Excel, wheredifferent statistical functions were used to analyze the results.

CHAPTER 03
RESULTS AND DISCUSSION

3.1.Proximate Analysis

The proximate compositions of chip samples are shown in Table 2.

Table 2: Mean values for the proximate composition of chip samples.

Samples	Moisture (%)	Ash (%)	Fat (%)	Fiber(%)
CC	1.70±0.06	3.26±0.07	49.74±0.98	4.01 ±0.02
CS	2.66±0.18	7.25±0.10	34.50±0.70	5.75 ±1.80
CP	12.10±1.79	6.24±0.28	24.36±0.21	7.55 ±2.83

Data are expressed as means of duplicate determinations.
CC:controlchips;CS: chipswithsesameseeds;CP:chipswithpumpkinseeds.

The mean moisture values found among all samples ranged from 1.70% to 12.10%, with the CP sample having the highest content (12.10%), followed by the CS sample (2.66%), and then the CC sample with the lowest content of 1.70%.

The moisture content of the potato chips (CC) obtained was 1.7%, which was in agreement with the findings of Tajner-Czopek et al. (2021), who reported that the moisture content of fried potato chips varies between 1.7–1.8%. While Sabraa et al. (2021) reported results higher than our results in their study on chemical composition and determination of acrylamide in fried potato chips, with a value of 10.12%. This discrepancy may be due to differences in frying conditions, such as temperature, duration, or potato variety.

The moisture content of the sesame chips (CS) was 2.66%, which was significantly lower than the 6.65% reported by Mostafa et al. (2024) in their study on chemical characteristics and nutritive quality of novel functional potato chip-like products. This noticeable difference in moisture level may be attributed to variations in the ingredients used and their amounts, such as ground flaxseeds, which contributed to water retention, or differences in pre-processing methods, such as drying or dough formulation.

The moisture content of the pumpkin seed chips (CP) in the current study was 12.10 %, which was considerably higher than the 1.3% reported by Fariha (2020) in baked tortilla chips supplemented with pumpkin seed flour. This significant difference may be attributed to the baking conditions, type of ingredients, and the content of water added; all of these factors could have influenced moisture retention.

The CC sample with the lowest moisture content in comparison with the CS and the CP samples could be explained by the use of boiled potatoes and added water in the CS and CP formulations, the cooking method, deep frying for the CC sample, and using the oven for the CS and the CP samples, and the temperature used. Furthermore, the added sesame and pumpkin flour, which have a moisture content of 3.75% (El-Enzi *et al*., 2018) and 6.4% (Fariha, 2020), respectively, may contribute to the higher moisture content. On the other hand, the moisture content of CP formulation was higher than the CS one's Nyam et al. (2013) reported in their study on the addition of pumpkin seeds into bread that pumpkin seeds increasedthe moisture content this might bedue to the higher water absorption capacityin the pumpkin seeds, which were high in fibre.

Ash values were obtained in ascending order as follows: 3.26%, 6.24%, and 7.25% for CC, CP, and CS samples, respectively.

The ash content of the CC sample was 3.26%, which was relatively close to the result reported by Sabraa et al. (2021) (3.11%). This minor difference could be related to the mineral composition of the raw potatoes. The ash content of the sesame chips (CS) in the present study was 7.25%, which was lower than the results reported by Mostafa et al. (2024) (8.37%-8.43%). This slight difference could be due to the addition of flaxseeds in the formulation of the authors. The ash content of the pumpkin seed chips (CP) in the present study was 6.24%, which was lower than the 9.9% reported by Fariha (2020) for baked tortilla chips enriched with pumpkin seed flour. This increase may be due to the nature of the ingredients used.

The ash results of the CS and CP samples were higher than those of the CC sample, and the ash content of CS (7.25%) was higher than that of CP (6.24%) because of the addition of sesame and pumpkin seeds, which had an ash content of 7.34% (Abbas *et al.*, 2022) and 6.90% (Devi *et al.*, 2018), respectively. This gives an idea of the inorganic content of the developed chips, from which the mineral content could be obtained.

The fat content results showed a clear variation. The fat content in CP was the lowest, at 24.36%, followed by the CS sample, at 34.50%, and the fat content in CC, at 49.74%. This variation reflects the fact that the method of cooking directly affects the fat content of the final product. The CC sample was cooked using deep frying; however, the CS and CP samples were cooked using an oven. Also, the amount of fat has generally been related to the amount of moisture lost (Basuny *et al.*, 2019), and the fat content is inversely proportional to moisture (Benedict and Ellis, 1987), which explains the high fat content of the CC sample. Despite that, the cooking method used for the CS and CP samples was the same but the CP sample had the lowest fat content because pumpkin seeds had a fat content of 37.9% (Fariha, 2020), which is lower than that of sesame seeds at 54% (Asghar *et al.*, 2014).

The results showed a variation in fiber content among the three samples studied. The CP sample recorded the highest value at 7.55%, followed by the CS sample with 5.75%, while the CC sample showed the lowest value at 4.01%.

The fiber content of the CC sample (4.01%) was similar to the findings of Khalil et al. (2023), who compared the fiber content in potato chips prepared from four different potato cultivars, with results ranging from 3.79% to 4.93%. Potato chips, on average, have a highly unbalanced nutritional composition; they arelow in fiber content (Fariha, 2020).

The CS and the CP samples had more dietary fiber than the commercial chips. This was since both pumpkin and sesame seeds led to an increase in the fiber content of the prepared chips, as the fiber content in pumpkin and sesame seeds was estimated to be 9.21%-10.63% (Singh and Kumar,2022)and 7.58%-14.9%(Nweke*et al*., 2011; Wei*et al*., 2022), respectively, depending on the cultivars.

The results illustrated that the fiber content improved when the potato chip-like formulations contained the added seeds. Similar to Mostafa et al. (2024), they noted that the content of fibers considerably improved in potato chip-like products when supplemented with whole ground sesame seeds. Also, Fariha (2020) conducted a study on baked tortilla chipsfortified with pumpkin seed flourat different levels. She found that the fiber content of the chips increased with increasing fortification level of pumpkin seeds.

3.2.Physico-chemical Analysis

3.2.1.pH Determination

The mean pH values of CC, CS, and CP samples are shown in Figure 2.

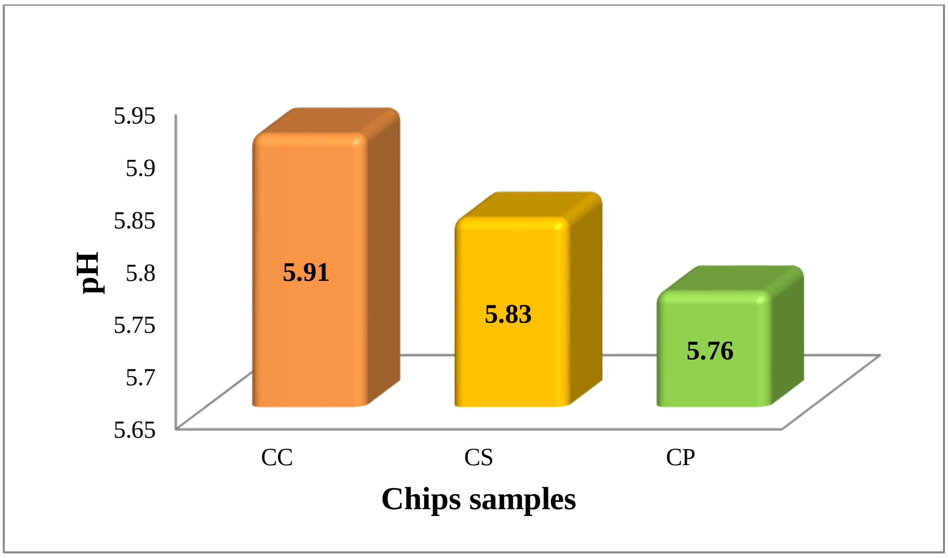

Figure 2: Mean values of pH for control chips (CC), chips with sesame seeds (CS), and chips with pumpkin seeds (CP).

In the current study, the pH results of the different chip formulations varied slightly,as all the samples shared the main ingredient of chips, which was potatoes. The pumpkin seed chips(CP) had a pH of 5.76, while the sesame chips(CS) recorded a slightly higher pH of

5.83. The fried potato chips (CC)exhibited the highest pH value at 5.91, this later depend on the pH of raw material used which is based on potato that has a pH of 7.3 resulting from thesoil, the cultivar, and fertilization as theyincrease the pH of the tuber pulp (dos Santos Viana*et al*., 2025). Also, Granda et al. (2004) reported that the pH value of fried potato chips varied between 6.04 and 6.10, which was close to our findings.

The pH value of the CP was slightly lower than the CS samples. According toGavril et al. (2024), the addition of dried pumpkin powder reduced the pH value, while the sesame seeds had a pH value of 6.41(Mustafa and Hüseyin, 2023). Thiscould be attributed to a higher pH value of the CS sample incomparison to the CP one.

3.3.Determination of Chemical Properties of Extracted Oils

3.3.1.Determination of Peroxide Value and Acidity Value

Table 3 showsthe peroxide values and acidity for the analyzed samples.

Table 3: Mean values for the PV and the acidity of chip samples.

	CC	**CS**	**CP**
Peroxide value (meq/kg)	0.96 ±0.08	2.13 ±0.08	1.76 ±0.12
Acidityvalue (%)	4.63 ±0.06	0.65 ±0.006	0.64 ±0.01

Data are expressed as means of duplicate determinations.
CC: control chips; CS: chips with sesame seeds; CP: chips with pumpkin seeds.

The peroxide value is a key indicator of lipid oxidation, providing insight into the primary oxidative degradation of fats and oils in food products(Kim*et al*., 2018).Sample CS recorded the highest value at 2.13 meq/kg, followed by sample CP with 1.76 meq/kg, while sample CC exhibited the lowest peroxide value at 0.96 meq/kg.

This parameter is particularly critical in assessing the quality of fat-containing food products such as potato chips. For instance, the sample CC’s peroxide value of 0.96 meq/kg fell well below the maximum limit of 6 meq/kg specified by the Polish Standard PN-A-74780 for fried potato snacks (Halagardaand Suwała, 2016).

Research by Adrover-Obrador et al. (2012) added that a PV below 1meq/kg is indicative of fresh oil, whereas values exceeding 10 meq/kg suggest rancidity. In the context of frying applications, high-quality vegetable oils generally exhibit peroxide values below 2 meq/kg (FAO/WHO, 2013). The result reflectedthe application of appropriate manufacturing practices, including the selection of suitable frying oils, control of frying conditions, and the use of protective packaging that limits exposure to oxidative agents such as light and air (Halagarda and Suwała, 2016).

In the case of sample CP, the peroxide value was determined to be 1.76 meq/kg. This alignedwith the PV of pumpkin seed oil reported by Abedand Khairy (2023), who found a PV of 1.70 meq/kg.However, when the authors added pumpkin seed oil to mayonnaise, they reported a peroxide value of 2.50 meq/kg, significantly higher than that observed inthe CP sample. This discrepancy may be primarily attributed to the analyzed food or differences in pumpkin varieties and oil extraction methods. Such factors critically influence the chemical profile of the oil, including its natural antioxidant content. Inadequate extraction techniques may lead to the degradation of antioxidants, thereby elevating the peroxide value (Abed and Khairy, 2023).

As for sample CS, the recorded peroxide value of 2.13 meq/kg was in agreement with that of Ujong et al. (2023), who found that the PV of sesame seeds was 2.13 meq/kg. Furthermore, Dim et al. (2013) andPopa et al. (2017) reportedvalues of 2.3 meq /kg and 1.8 meq/kg, respectively,for sesame seed oil, while broader literature placed sesame oil PVs between 0.14 and 9.4 meq/kg (Abdulsalam and Sheet, 2022).

If we compare the results of the three samples, we found that the CC sampleshowed the lowest peroxide value at 0.96 meq/kg. Mayhap due to the packaging type used and the preservatives added to the purchased chips that inhibit the oxidation of lipids. Although the CS and the CP samples were in the same packaging conditions, the CS sample had the highest PV value, whichwas possible because of the high content of fat in comparison with the CP sample's content, which contributed to a higher PV (Piyalungka*et al*., 2019).On the other hand,the higherunsaturated fatty acids content, the higher PV, in the case of pumpkin seed oil,hasan unsaturated fatty acids content ranging from 70.69 to 73.30% (Abed and Khairy, 2023), while, sesame seed oil, the total unsaturated fatty acids constituted more than 82% (Agidew *et al*., 2021).

In summary, the peroxide value analysis across all the extracted oils of the three samples, CS, CP, and CC,remained below the Codex Alimentarius Commission's rejection limit of 10 meq/kg for fats and oils(CODEX, 2011), suggesting that the samples' oilshad not undergone significant degradation.

The acidity value indicates the amount of free fatty acids in food products. The lower the value, the higher the quality of the fat present in the food(Zhang *et al*., 2015). The acidity value of CC (4.63%)was the highest among the three samples, while those of CS and CPhad almost the same value, 0.65% and 0.64%, respectively.

In a study conducted by Halagarda and Suwała (2016), seven commercial brands of potato chips were analyzed. They noted acid values ranging from 0.35 mg KOH/g to 0.91 mg KOH/g, which were higher than those of the CC sample. Additionally, the CC sample's acidity value was lower than those reported by Zychnowska et al. (2015), who analyzed the acidity of fats in fried potato chips, with results ranging from 0.25 to 1.53 mg KOH/g. This variability may be attributed to the differences in raw materials, storage methods, and the level of heat exposure during frying (Zychnowska *et al*., 2015; Halagarda and Suwała, 2016).

The acid value of the CP sample was lower than 1.32 mg KOH/g, noted by Hagos et al. (2023), who analyzed pumpkin seed oil. They explained that the higher acidity may be contributed to the enzymatic hydrolysis of fats or improper storage conditions of the seeds before oil extraction. In addition, Samuel et al. (2017) examined the acidity value of oils from fluted pumpkin seeds and shea butter to assess their potential in food industry applications. They noted an acid value of 1.41 mg KOH/g for pumpkin seeds, which was higher than the value of sample CP.

The acidity value of the CS sample was lower than those foundby Hassan and Wawata (2019) andBorchani et al. (2010), who found values of 2.50 mg KOH/g and 1.64 mg KOH/gfor sesame oil, respectively. The lower value of the CS sample may be due to the favorable storage conditions and the proper extraction process(Borchani*et al*., 2010; Hassan and Wawata, 2019).

3.4.DPPH Radical Scavenging Activity

The comparative analysis of DPPH radical scavenging activity among the three samples, CS,CP,and CC, revealed significant differences in their antioxidant potential (Table 4). CS exhibited the highest scavenging activity at 8.01%, indicating the strongest antioxidant capacity, CP followed with a moderate activity of 6.35%, while CC showed the lowest at 5.17%. These results suggested the ranking in antioxidant effectiveness as follows: CS > CP > CC.

Table 4:DPPH radical scavenging activity of chip samples.

	CC	**CS**	**CP**
DPPH (%)	5.17 ±0.65	8.01 ±1.63	6,35 ±0.47

Data are expressed as means of duplicate determinations.

CC: control chips; CS: chips with sesame seeds; CP: chips with pumpkin seeds.

The strongest antioxidant capacityof the CS sample observed was attributed to the elevated content of phenolic compounds and other bioactive substances in the sesame extracts (Ruslan*et al*., 2018),indicating a strong ability of sesame seeds to neutralize free radicals, highlighting their potential as safe, natural alternatives in food preservation. These findings highlight the potential of utilizing these seeds as health-promoting sources to enhance food quality and extend shelf life due to their natural antioxidant properties(Ruslan *et al*., 2018; Askander *et al*., 2023).

The CP sample demonstrated remarkably higher DPPH scavenging activity in comparison with the CC sample. This high activity was attributed to the rich phenolic content of the pumpkin seed extracts, supporting the notion that phenolic compounds play a crucial role in enhancing antioxidant activity (Nyam *et al*., 2013).

Further supporting evidence comes from the study by Hussain et al. (2022), in which ethanolic extracts of pumpkin seeds were evaluated for their antioxidant properties using the DPPH assay. The results showed a concentration-dependent increase in activity, with a maximum scavenging effect of 56.10% at 2 mg/mL. This reinforces the potential of pumpkin seed extracts as effective antioxidants, especially when appropriate solvents and concentrations are employed.

The higher DPPH scavenging activity of the CP sample in comparison with that of the CP sample could be attributed tothe specific type and relative concentration of individual phenolic compounds may have a more significant impact than the overall phenolic contentalone(Xanthopoulou*et al*., 2009).

The DPPH scavenging activity of the CC sample contributed to that potatoes contain antioxidants as phenolic acids,ascorbic acid, and carotenoids (Ali *et al*., 2019). The processing steps of potato chips lead to the loss of many nutrients, which become low in vitamins and antioxidants(Mostafa *et al.*, 2024), resulting in a low DPPH scavenging activity.

3.5.Sensory Evaluation

Sensory evaluation scores of chip samples are shown in Figure 3. According to the results obtained, the control sample (CC) was the most preferred by the panelists across all evaluated attributes, compared to the CS and CP samples.

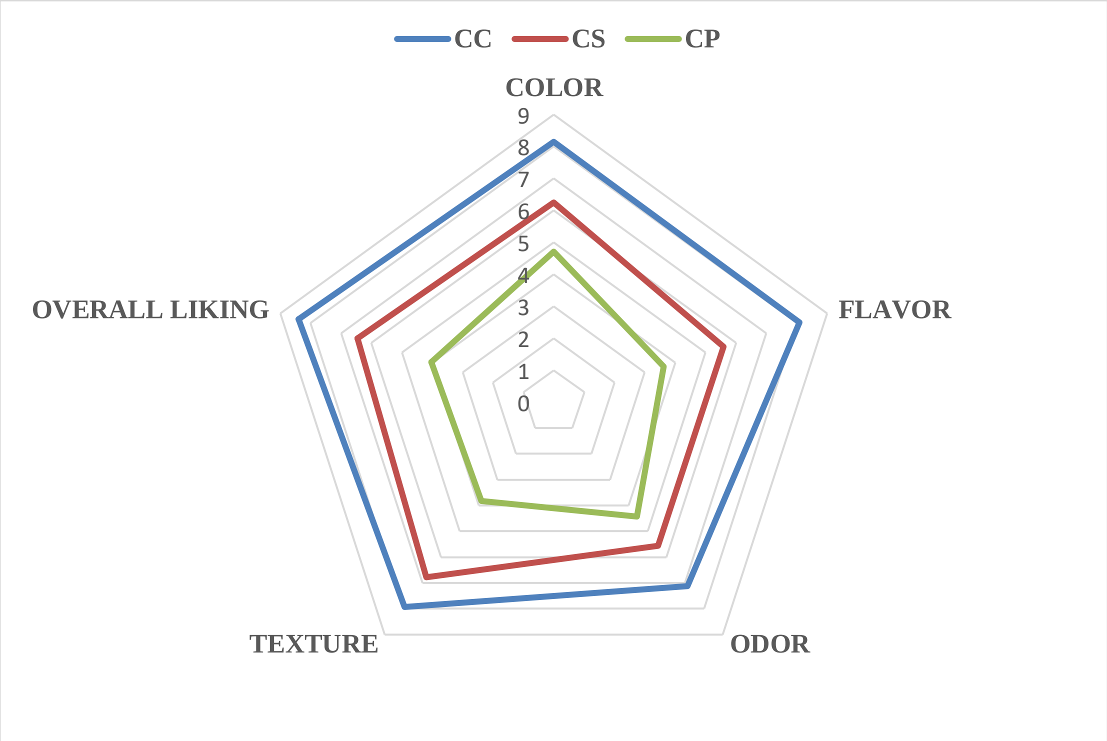

Figure 3: Sensory scores of control chips (CC), chips with sesame seeds (CS), and chips with pumpkin seeds (CP).

The color score of the CC sample was the highest score, with an average of 8.15. The result obtained may be attributed to the Maillard reaction between stored sugars and amino acids that occurs during frying, which leads to the formation of colored compounds that give potato chips their attractive appearance. Additionally, frying time and temperature play a crucial role in enhancing this color (Halagarda and Suwała, 2016).In contrast, the unfried samples, CS and CP, received scores of 6.25 and 4.71, respectively. These ratings were acceptable and expected for a functional potato product that contains sesame and pumpkin seeds, which led to a somewhat darker color.The relatively lower appearance scores observed for the unfried CS and CP samples may be attributed to the inclusion of sesame and pumpkin seeds, respectively. These seeds are known to contribute distinct colors—brownish and greenish hues—which could have negatively influenced the visual appeal of the products. This difference in surface color may have contributed to a less uniform or less appealing appearance, thereby affecting panelist perception.

The CC sample had the highest texture score, with an average of 7.93, whichcould be attributed to the frying process of the potato chips in hot oil at high temperatures for several minutes, resulting in moisture loss and a crispier, more appealing texture (Halagarda and Suwała, 2016).Whilethe CS sample received a slightly lower score of 6.78, the CP sample had the lowest texture score of 3.84. The softer texture of CP is due to its higher content of moisture, due to the higher water absorption capacityin the pumpkin seeds, which were high in fibre(Nyam*et al.*, 2013).

Depending on the results obtained, the CC sample received the highest scores in terms of flavor and odor, with values of 8.09 and 7.12, respectively. The odor of fried potato chips mainly resulted in the formation of compounds such as methional and methionine. The flavor, on the other hand, depends largely on the intrinsic compounds present in the potatoes, the type and quality of the oil used, and the amount of added salt (Halagarda and Suwała, 2016).

Supplementation of chips with sesame and pumpkin seed flour significantly affected the odor and flavor of the produced chips.For the CS sample, the average scores for both odor and flavor were 5.56 and 5.59, respectively. The CP sample, however, received the lowest scores, 4.43 for odor and 3.62 for flavor. The development of flavor could be attributed to the roasting of sesame and pumpkin seeds during processing, which resultedin the development of aroma characteristics in seeds (Fariha, 2020),and the low amount of added salt in the two formulations.

The overall liking parameter for the CC and the CS samples showed that the obtained values were above the acceptable limit for the product (i.e., score 5, which indicates “neither like nor dislike”), where the CC sample had the highest score of 8.40, followed by the CS sample with a score of 6.46. The CP sample showed the lowest overall liking score (4.03), which was considered unacceptable, as a result of low color, texture, odor, and flavor scores, indicating that the addition of pumpkin seeds appeared to have greatly influenced the overall liking of the product

CONCLUSION AND RECOMMENDATIONS

Conclusion

The present research was designed to develop a formulation of functional healthy baked potato chips fortified with whole ground sesame and pumpkin seeds and to study their characteristics. The control (CC) sample had lower moisture, protein, and fiber but higher fat than the sesame (CS) and pumpkin (CP) seed samples, due to seed addition and cooking method. All samples had similar pH levels, with CP slightly lower due to pumpkin powder. CS showed the highest peroxide value (PV), followed by CP, while CC had the lowest, likely due to packaging and preservatives.

CS's high PV was linked to its higher fat and unsaturated fatty acid content compared to CP.The CC sample recorded the highest acidity value among the samples. In contrast, the CS and CP samples showed similar values, which can be attributed to the natural properties and proper storage conditions of the added seeds.The CS’s highest antioxidant capacity in comparison with the other samples was attributed to its high content, type, and concentration of individualphenolic compounds.

In terms of sensory evaluation, the addition of seeds,preparation steps, and cooking method significantly affected the perception of the final product, although the CC sample was the most preferred by panelists across all sensory attributes. The CP sample received the lowest overall liking score, suggesting that the addition of pumpkin seeds significantly affected product acceptability.

Recommendations

- The present study can be further expanded by doing the protein dosage as well as the types of amino acids present, the fatty acid profile, vitamins, and minerals, to have more information from a nutritional point of view.
- It is recommended to do the microbiological analysis to get more information on the quality and safety of these chip formulations, and to study their shelf life.
- Further research has to be carried out by preparing different formulations with different concentrations of seeds to meet consumer demands for tastier chips.
- The addition of natural antioxidants combined with suitable packaging should be considered a good method to maintain the microbiological and biochemical qualities of the developed chips.

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APPENDIX

Questionnaire for the hedonic scale used in the sensory evaluation of the different chipformulations.

Panelist:

Place the number in the blank space provided below the statement that best describes yourimpression. Check only one response per question **<u>and be sure that you respond to eachquestion.</u>** Be sure the number below matches the code on the sample.

Please evaluate the product in front of you by looking at it and tasting it. Considering only theattribute described of this product, which statement below best describes your impression?

Dislike Extremely	Dislike Very Much	Dislike Moderately	Dislike Slightly	Neither nor Dislike	Like Slightly	Like Moderately	Like Very Much	Like Extremely
1	2	3	4	5	6	7	8	9

Sample Number	Color	Flavor	Odor	Texture	Overall liking
510					
554					
112					

Now you have tasted the products, please rank them from most preferred to least preferred:

Annexe

فهرس المحتويات

المحور الأول :

تقديم المشروع

المحور الأول: تقديم المشروع

1- فكرة المشروع:

- مجال النشاط هو الصناعة الغذائية الصحية (إنتاج رقائق الشيبس النباتية الصحية من البطاطا المفورة مع بذور اليقطين وبذور السمسم)

- يُقترح هذا المشروع استجابةً للطلب المتزايد على الأغذية الصحية الطبيعية، في ظل التحول العالمي نحو أنماط استهلاك واعية تهدف إلى تقليل الدهون المشبعة، الملح المضاف، والمواد الحافظة الصناعية. يبرز هذا الاهتمام خاصة لدى فئة الأطفال، الرياضيين، والبالغين الراغبين في بدائل صحية لوجباتهم الخفيفة اليومية

- يتميز المشروع باستعمال البطاطا المفورة بدل المقلية، ما يقلل من نسبة الدهون، ويُحافظ في الوقت نفسه على المذاق المرغوب والملمس المقرمش. كما يُدمج بذور اليقطين أو بذور السمسم، وهي مواد طبيعية غنية بالبروتين النباتي، الألياف، المعادن، والأحماض الدهنية الصحية، مما يعزز القيمة الغذائية للمنتج بشكل واضح .

- تتمثل فكرة المشروع في تصنيع رقائق شيبس صحية مبتكرة، منخفضة الدهون والأملاح، خالية من المواد الحافظة، وبنكهات طبيعية أو عشبية خفيفة. يتم ذلك عبر عملية إنتاجية مبسطة تجمع بين التبخير (لتسوية البطاطا دون زيت غزير) وطحن وتحميص خفيف للبذور لضمان جودة ونكهة مميزة. يتم خلط المكونات بنسب مدروسة للحصول على عجينة متجانسة تُفرد وتُقطع وتُطهى في الفرن أو الهواء الساخن للحصول على منتج نهائي مقرمش وصحي

-مكان المشروع هو حي بومهرة احمد تم اختياره لقربه من مدينة قالمة (سهولة الوصول للعمالة والخدمات) وقربها من الطرق الوطنية (سهولة النقل والتوزيع)، تبعد حوالي 10 الى 20 كم عن المناطق الزراعية المنتجة للبطاطا

ومتوفرة فيها الكهرباء والمياه، كما تتوفر أيضا العقارات الجاهزة للتأجير او الاستثمار

المواد الأولية:

- نوعية البطاطا (طازجة، خالية من العيوب، محتوى الرطوبة مناسب

- جودة بذور اليقطين / السمسم (نظيفة، طازجة، عالية الجودة)
- نوعية الملح المستخدم (قليل الصوديوم)
- جودة المياه (صالحة للشرب وخالية من الشوائب)

اليد العاملة:

- مستوى التدريب على التشغيل الصحي للآلات
- الوعي بممارسات النظافة والسلامة الغذائية
- مهارات التحكم في درجات الحرارة ووقت الطهي

الآلات والتقنيات:

- كفاءة آلات التقطيع
- الصيانة الدورية لتقليل الأعطال
- استخدام معدات تغليف صحية ومحكمة الغلق

طرق العمل:

- تحديد مراحل العمل (الغسل، التقشير، التقطيع، النقع، الطهي، التغليف)
- التحكم في درجة الحرارة ومدة الطهي
- إضافة النكهات الصحية في الوقت المناسب
- مراقبة نسب الملح لتقليل الصوديوم

البيئة:

- درجة حرارة ورطوبة منطقة الإنتاج
- نظافة الورشة ومحيطها
- التخلص السليم من النفايات
- الالتزام بالإجراءات الصحية والبيئية

المراقبة والجودة:

- مراقبة الجودة الدورية للمواد الخام والمنتج النهائي
- اختبار الطعم، القرمشة، نسبة الزيت، نسبة الرطوبة
- احترام معايير السلامة الغذائية الوطنية
- تتبع مصدر المواد الأولية لضمان سلامتها

2- القيم المقترحة:

القيم الاقتصادية:

الربحية: يعتبر مشروع الشيبس الصحي ذا أهمية ومكانة متنامية في السوق المحلية والعالمية، نظرًا لزيادة الطلب على الوجبات الخفيفة الصحية.

خلق فرص العمل: يساهم المشروع في توفير فرص عمل متنوعة في المنطقة (النقل، التصنيع، التسويق)

تعزيز الاقتصاد المحلي: يهدف المشروع إلى دعم التنمية الاقتصادية المحلية في الجزائر من خلال استغلال البطاطا المحلية والمواد الأولية المتوفرة

تشجيع النشاط التجاري: يدعم المشروع إنشاء سلاسل توزيع وتسويق محلية ووطنية، ويحفز الاستثمار في القطاع الغذائي الصحي

القيم البيئية:

الحفاظ على الموارد الطبيعية: يعتمد المشروع على تقنيات تصنيع صديقة للبيئة، من خلال تقليل استهلاك الطاقة وإعادة استخدام بقايا البطاطا كأعلاف أو أسمدة

تشجيع الممارسات الزراعية المستدامة: يحفز المشروع المزارعين على اتباع أساليب زراعة صديقة للبيئة لضمان جودة المواد الأولية

القيم الاجتماعية:

تعزيز التجارة العادلة: يهدف المشروع إلى ضمان أسعار عادلة للمزارعين المحليين مقابل تزويدهم بالبطاطا والمواد الأولية

الحفاظ على العادات الغذائية الصحية: يشجع المشروع المستهلكين على تناول وجبات خفيفة صحية أقل دهونًا وملحًا، ما يساهم في تحسين الصحة العامة

المساهمة في الأمن الغذائي: من خلال تصنيع منتج غذائي صحي محلي يقلل الاعتماد على الواردات

القيم النوعية:

جودة المنتج: يهدف المشروع إلى إنتاج شيبس صحي بجودة عالية، يستخدم تقنيات الخبز في الفرن، مع احترام معايير الجودة الوطنية والدولية

إمكانية التتبع: تنفيذ نظام تتبع لضمان سلامة المنتج من المزرعة إلى المستهلك

الابتكار: تطوير وصفات شيبس صحية باستخدام بذور السمسم وبذور اليقطين كمنكهات طبيعية صحية، وإعادة تدوير المخلفات في تصنيع منتجات مشتقة مثل الدقيق الغني بالألياف

القيمة العلمية والتكنولوجية:

البحث والتطوير: يساهم المشروع في تطوير تقنيات التصنيع الغذائي منخفضة الدهون وابتكار منتجات جديدة بتركيبات صحية

الصحة العامة: يساهم المشروع في تقديم بدائل صحية في السوق للحد من الأمراض المرتبطة بالاستهلاك المفرط للدهون والملح

نقل التكنولوجيا: يتيح المشروع فرصة تطبيق تقنيات حديثة في صناعة الأغذية الصحية في الجزائر

3- فريق العمل:

الطالبة1: براهيمي مريم متخصصة في جودة المنتجات والامن الغذائي في جامعة 8 ماي 1945 وهي خريجة ليسانس تكنولوجيا الأغذية ومراقبة النوعية من جامعة 8 ماي 1945 للسنة الدراسية 2022 -2021.

كما قامت **بدورة تدريبية لمدة 15 يومًا** على مستوى **مركز تطوير المقاولتية،** ما سمح لها بتعزيز معرفتها بالجوانب الريادية والتنظيمية للمشاريع.

الطالبة2: كعور شروق متخصصة في جودة المنتجات والامن الغذائي في جامعة 8 ماي 1945 وهي خريجة ليسانس تكنولوجيا الأغذية ومراقبة النوعية من جامعة 8 ماي 1945 للسنة الدراسية 2022 -2023 .

كما قامت **بدورة تدريبية لمدة 15 يومًا** على مستوى **مركز تطوير المقاولتية،** ما سمح لها بتعزيز معرفتها بالجوانب الريادية والتنظيمية للمشاريع.

4-أهداف المشروع :

- يهدف هذا المشروع إلى تقديم بديل صحي محلي الصنع لمنتجات الشيبس الصناعية المستوردة أو المحلية التي تعتمد القلي العميق والمواد المضافة بكثرة. ويعتمد على مواد أولية متوفرة محليًا مثل البطاطا، بذور اليقطين، وبذور السمسم، ما يعزز من الجدوى الاقتصادية والاستدامة البيئية.

كما يتميز هذا المشروع بآفاق اقتصادية واجتماعية مهمة، إذ يمكنه:

- خلق فرص عمل مباشرة وغير مباشرة في مراحل الإنتاج، التعبئة، والتوزيع
- دعم الفلاحين من خلال شراء المواد الأولية محليًا
- الاستجابة لمتطلبات الصحة العمومية عبر توفير أغذية صحية تقلل من أمراض مرتبطة بالتغذية كالسمنة وأمراض القلب

فتح المجال أمام الشباب وخريجي علوم الأغذية، الزراعة، والتغذية للعمل في مشروع يدمج الابتكار والجودة

5- الجدول الزمني :

الشهر او الاسبوع

		1	2	3	4	5	6	7
1	الدراسات الاولية :اختيار مقر الوحدة الانتاجية,تجهيز الوثائق المطلوبة		✓	✓				
2	طلب التجهيزات من الخارج			✓	✓			
3	بناء مقر للانتاج (المصنع)			✓	✓	✓		
	تركيب المعدات				✓	✓	✓	
	اقتناء المواد الاولية		✓	✓				
	بداية انتاج اول منتج							✓

المحور الثاني:

الجوانب الابتكارية

المحور الثاني: الجوانب الابتكارية

1- طبيعة الابتكارات:

- تلبية الطلب المتزايد على المنتجات الصحية والطبيعية قليلة الدهون وقليلة الإضافات الصناعية
- المساهمة في تحسين النظام الغذائي المحلي وتقليل الاعتماد على الوجبات الخفيفة المستوردة غير الصحية
- إدخال وصفات جديدة تجمع بين مكونات محلية (بطاطا، بذور اليقطين، بذور السمسم) ومعالجة صحية (تبخير، تحميص، تقليل الزيوت)
- تطوير عبوات مبتكرة وصديقة للبيئة (قابلة لإعادة التدوير أو تحلل بيولوجيًا)
- إنشاء قناة بيع إلكترونية لتسويق الشيبس الصحي والتواصل المباشر مع المستهلكين
- إشراك الزبائن في تحسين النكهات من خلال اختبارات تذوق ومسابقات، لضمان تلبية الأذواق المحلية
- إجراء بحوث لتأكيد الفوائد الغذائية للمنتج وتحديد تطبيقات جديدة مثل شيبس للأطفال أو الرياضيين
- تقديم منتج بديل صحي يدعم الأمن الغذائي ويعزز قيمة المنتجات الزراعية المحلية

2- مجالات الابتكار:

- المشروع مبتكر في كونه من أوائل مبادرات تصنيع شيبس صحي طبيعي في الجزائر
- يساهم في تطوير قطاع الصناعات الغذائية(ذات الطابع الصحي) محليًا وتوفير مناصب شغل جديدة
- يمكن تسويقه في المتاجر الكبرى والصيدليات ومتاجر الأغذية العضوية
- يتيح فرصًا للتصدير في الأسواق المغاربية والأفريقية مستقبلاً
- يدعم الابتكار الاجتماعي من خلال شراكات مع تعاونيات زراعية محلية ومصانع تغليف صديقة للبيئة

المحور الثالث:

التحليل الاستراتيجي للسوق

المحور الثالث: التحليل الاستراتيجي للسوق

1-شريحة السوق:

السوق المحتمل: يشمل فئات يمكن جذبها لاحقًا مثل الأطفال، مراهقين، كبار السن، والمقاهي أو المطاعم. مع تطوير نكهات وتغليف مناسب، يمكن توسيع قاعدة الزبائن والوصول إلى جمهور أكبر مستقبلاً.

السوق المستهدف: يشمل فئات تهتم بالتغذية الصحية مثل الرياضيين، متّبعي الحميات، والمرضى والنباتيين، والأمهات الباحثات عن سناكات طبيعية لأطفالهم. هذه الفئة تبحث عن منتجات غير مقلية وغنية بالقيمة الغذائية، ما يجعلها الزبون المثالي للمنتج.

أسواق متخصصة: محلات الأغذية العضوية، محلات التغذية الرياضية، الصيدليات (للأصناف الصحية المميزة)، وكذلك البيع عبر الإنترنت وتطبيقات التوصيل.

2-قياس شدة المنافسة:

المنافسة في سوق الشيبس التقليدي قوية جدًا مع علامات تجارية محلية (سلطان, مهبول,ريفكيس,العائلة, ماستر شيبس, شريكي ,كرانشي,شيبسي, ليز الجزائرية) ودولية (ليز بيبسيكو, برينغل,دوريتوس,شيتوس)ذات أسعار منخفضة وشهرة واسعة.

لكن في فئة "الشيبس الصحي" المنافسة ضعيفة نسبيًا وتعتبر سوقًا ناشئة في الجزائر، مع وجود عدد محدود من البدائل المستوردة بأسعار مرتفعة.

أهم نقاط قوة المنافسين المحتملين: وفرة التوزيع، الأسعار التنافسية، الإعلانات الضخمة.

أهم نقاط ضعف المنافسين في هذه الفئة: قلة الخيارات الصحية الحقيقية، نقص الاعتماد على مكونات طبيعية ومحلية، ضعف الثقة في القيمة الغذائية للمنتجات المستوردة مرتفعة السعر.

3-استراتيجية التسويق:

- نقدم منتجًا مبتكرًا وصحيًا بسعر في المتناول، يجمع بين الطعم اللذيذ والقيمة الغذائية، ونؤكد على مصدره المحلي (دعم الفلاحة الجزائرية)
- سنعتمد على تغليف جذاب ومعلومات شفافة عن المكونات والقيمة الغذائية.
- المشاركة في المعارض والفعاليات الغذائية والصحية للتعريف بالمنتج.
- بناء حضور رقمي قوي: صفحة فيسبوك وإنستغرام وتطبيقات التوصيل مع عروض ترويجية.
- تقديم عينات مجانية وعروض تعريفية للمحال الكبرى والصيدليات ومتاجر الأغذية الصحية.
- العمل على برامج ولاء وعروض خاصة للعملاء الدائمين.
- فهم المنافسين واحتياجات العملاء بشكل مستمر من خلال دراسات السوق وتحسين الوصفة والتغليف والتسعير.

- **ندرس المزيج التسويقي** 4ps

المنتج :(Product) شيبس صحي بنكهات مبتكرة.

السعر :(Price) سعر مدروس منافس.

المكان :(Place) توزيع واسع في المتاجر والصيدليات وعبر الإنترنت.

الترويج :(Promotion) إعلانات رقمية، عينات مجانية، شراكات مع النوادي والمدارس.

- **دراسة SWOTالمشروع :**

نقاط القوة : (strengths)

- وصفة صحية مبتكرة (بطاطا-بذور طبيعية)
- سعر جملة تنافسي (30دج/علبة)
- جودة مراقبة بمخبر داخلي صغير
- تغليف مطبوع وجذاب مع معلومات غذائية
- استعمال مكونات محلية متوفرة
- القدرة على انتاج كميات كبيرة بنظام8*3

نقاط الضعف: (weaknesses)

- اعتماد كبير على موردين (بذور مستوردة احيانا)
- تكاليف ثابتة عالية نسبيا للاجور (24عامل بنطام 8*3)
- ضعف وعي المستهلك بالتغذية الصحية.
- ضعف القدرة التسويقية مقارنة بالعلامات الكبرى
- حاجة مستمرة الى النقل و التوزيع المنتظم
- محدودية في النكهات /انواع اخرى بالانطلاق الاولي

الفرص(Opportunities):

-امكانية التوسع لاسواق الولايات الاخرى

- اطلاق نكهات جديدة (بالاعشاب...)
- ازدياد الطلب على الاغذية الصحية في السوق الجزائري
- امكانية البيع بالتجزئة بسعر اعلى (45/40دج /علبة)
- دعم الدولة للمؤسسات المصغرة /- شراكات مع نوادي و المدارس

التهديدات : (Threats)

- المنافسة قوية من شيبس تقليدي ارخص
- تقلب اسعار المواد الاولية (البذور/البطاطا)
- تغيراذواق المستهلكين بسرعة
- تضخم وتغير في تكاليف الطاقة والنقل

المحور الرابع:
خطة الإنتاج والتنظيم

المحور الرابع: خطة الإنتاج والتنظيم

1- عملية الإنتاج:

01

تفوير البطاطس

تفوير البطاطس حتى تصبح طرية.

02

تقشير البطاطس

تُقشر البطاطس بعناية لإزالةالقشرة

03

هرس البطاطس

تُهرس البطاطس حتى تصبح ناعمة.

04

تنظيف البذور

نُظفت بذور السمسم وبذور اليقطين بالفرز لإزالة

05

طحن البذور و غربلتها

تحويل البذورإلى مسحوق ناعم

06

تكوين العجينة: أضيفت بذور السمسم واليقطين المطحونة إلى البطاطا مع اضافة(ملح+ماء).

07

تشكيل الرقائق:

شُكلت العجينة لتُصبح على هيئة رقائق الشيبس باستخدام أداة تشكيل خاصة.

08

الخبز في الفرن:

خُبزت الرقائق في فرن على درجة حرارة 180 درجة مئوية لمدة 10 دقائق .

09

التعبئة والتغليف:

عُبئت العينتان من الرقائق في أكياس بولي إيثيلين محكمة الإغلاق وحُفظت في درجة حرارة الغرفة.

2- التموين :

سياسة الشراء للمواد الأولية

(بطاطا, بذور اليقطين , بذور السمسم , ملح , ماء مفلتر من وحدة داخلية) المواد الأساسية:

سياسة الشراء:

-دورية الشراء: كل شهر أو كل 15 يومًا للبطاطا الطازجة

-كمية الأمان تخزين 1.5 × الكمية الشهرية للبذور (تكفي لشهر ونصف)

-معايير الجودة مكونات نظيفة، غير فاسدة، مرخصة غذائيًا، محفوظة جيدًا-

-لتعاقد عقود نصف سنوية مع موردين معروفين لضمان السعر الثابت-

-الدفع 50% عند الطلب، و50% عند الاستلام (أو بعد 7 أيام)-

-التسليم إلى باب المصنع

سياسة الشراء للمواد الثانوية (لوازم التغليف والتعبئة):

المواد:(أكياس بلاستيكية مطبوعة,كرتون, حبر الوسم, ملصقات)

-دورية الشراء كل 2 أو 3 أشهر (لتخفيض السعر عبر الكمية)

-كمية الأمان مخزون 3 أسابيع دائمًا داخل المصنع

-معايير الجودة طباعة واضحة، أكياس غذائية مرخصة، كرتون غير قابل للرطوبة

-التعاقد عقد بـ(الدفعات) مع مورد التغليف الوطني

-الدفع 100% عند الطلب

-التسليم خلال 15 يوم من التصميم والموافقة

سياسة شراء التجهيزات (معدات / آلات):

آلات الإنتاج (مفور، فرن، عجانة..),أجهزة المخبر,وحدة التصفية

-الشراء يتم مرة واحدة في البداية – شراء رأسمالي

- الصيانة عقد سنوي مع المزود (أو فني محلي)

- الضمان 1–2 سنوات – يجب المطالبة به رسميًا

- الدفع يفضل: 60% عند الطلب + 40% عند الاستلام / التركيب

-التسليم بين 7 إلى 30 يوم – حسب المورد

دفتر التموين الداخلي:

جدول أسبوعي لحركة المخزون(In/Out)

طلب شراء قياسي داخلي(Bon de commande)

تقييم الموردين كل 3 أشهر (جودة – سعر – احترام المواعيد)

قائمة اهم الموردين:

Fournisseur	Activité	Téléphone
AlaaGraines DZ	Graines de sésame et courge (gros)	0554 66 89 00
Maghreb Graines	Importateur degraines	0552 31 22 84
ENSel – Unité deGuelma	Sel alimentaireraffiné	037 27 43 45
Plastic Pack DZ	Sachets imprimés,machines à sceller	0553 44 00 12
Mister Emballage	Sachets personnalisés	0552 37 97 76
Carton EmballageAlgérie	Cartons imprimésen gros	0552 37 97 76
Hamoudi Equipements	Fours, pétrins,cuiseurs, machines	0552 86 89 21
Hydrotech DZ	Système defiltration RO + UV	0555 58 78 65

1- اليد العاملة:

مشروعنا يخلق حوالي 24 منصب عمل ,لا يحتاج مشروعنا الى تخصصات دقيقة الا فيما يخص التقنيين العاملين في مخبر مراقبة الجودة

2-الشراكات الرئيسية:

اهم الشراكات في مشروعنا كانت مع الموردين لأهميتهم في انجاز المشروع وشركات النقل والعملاء الرئيسيون تجار الجملة والتجزئة ...ومزودو الخدمات بالإضافة الى حاضنة الاعمال لجامعة قالمة

المحور الخامس:
الخطة المالية

المحور الخامس: الخطة المالية

1-التكاليف والاعباء:

التكاليف الثابتة:

البيان	**المبلغ (شهريا)**	**المبلغ (سنويا)**
المبنى	40 000.00	480000.00
الآلات	1 068 500.00	/
تجهيزات مكتبية	50000.00	/
المجموع	**1158500.00**	/

désignation	**prix**
Cuiseur vapeur pour pommes de terre	110 000.00
Presse-purée électrique ou mécanique Moulinex	22 000.00
Torréfacteur de graines(petit)Oztiryakile	40 000.00
Moulin électrique à graines Kenwood	35 000.00
Pétrin industriel (10–15 kg)	55 000.00
Laminoir / découpeuse pour pâte en chips	95 000.00
Four industriel (chaleur tournante ou statique)	260 000.00
Soudeuse à sacs plastique / scelleuse thermique	28 000.00
Table de travail en inox	17 000.00
Balance numérique industrielle	8 500.00
Étagères de stockage inox/métal	22 000.00
Équipements de laboratoire (6 pièces)	225 000.00
Unité de filtration RO + UV (eau potable)	100 000.00
Totale	**927500.00**

التكاليف المتغيرة كل شهر:

المادة	السعر (دج/كغ او لتر)	الكمية الشهرية	السعر الاجمالي
بطاطا	60.00da/kg	2859kg	171540.00da
بذور اليقطين	600.00da/kg	357kg	214200.00da
بذور السمسم	400.00da/kg	357kg	142800.00da
ملح	25.00da/kg	48kg	1200.00da
ماء	1.00da/l	238 l	238.00da
كيس التغليف	2.5.00da	88000	220000.00
كرتون	50.00da	1100	55000.00
طباعة ووسم	28000.00da	/	/
صيانة ونظافة	10000.00da	/	/
ماء والكهرباء	40000.00da	/	/
تشغيل وحدة التصفية	5000.00da	/	/
		المجموع	888000.00

- التموين يكون من طرف حاضنة الجامعة 8 ماي 1945 قالمة

كيفية استرداد الأموال (جدول العوائد):

الاستثمار الاولي: 1068500.00da

الربح الصافي السنوي: 9110304.00da

مدة الدراسة: 5سنوات

معدل الخصم van: 10%

جدول العوائد:

السنة	التدفق السنوي(دج)	معامل الخصم %	القيمة الحالية(دج)
0	-1068500.00	1.000	-1068500.00
1	9110304.00	0.909	8282094.00
2	9110304.00	0.826	7527358.00
3	9110304.00	0.751	6844871.00
4	9110304.00	0.683	6222610.00
5	9110304.00	0.621	5658286.00
		مجموع القيم المخصومة	33466719.00

Van: 33466719087.00da

الاستثمار يسترجع كليا خلال السنة الأولى حتى مع الخصم (10%سنويا)

2-رقم الاعمال:

سعر الكيس الواحد للشيبس 30 دج

الإنتاج اليومي	2933.00كيس
رقم الاعمال اليومي	87990.00دج
رقم الاعمال الشهري	2640000.00دج
رقم الاعمال السنوي	31680000.00دج

3-جدول حسابات الناتج المتوقع

- ✓ اجمالي المبيعات والاعباء خلال سنة

البيان	القيمة(دج)
رقم الاعمال السنوي	31680000.00
الاعباء السنوية الكاملة	22569696.00
النتيجة السنوية(ربح او خسارة)	+9110304.00

خلال سنة محاسبية واحدة المصنع يحقق رقم اعمال 31680000.00دج يغطي اعباءه 22569696.00دج وينتهي برصيد ايجابي 9110304.00دج ربح صافي

- ✓ حساب احتياجات راس المال العامل (BFR) :

هي المبلغ اللازم لتسيير الدورة الشهرية (شراء ,تخزين, بيع اجل) ويحسب كالتالي:

BFR= الموردين (الدفع الاجل)-المخزون +الزبائن (الديون)

العنصر	القيمة التقديرية (دج)	الملاحظة
المخزون	578480.00	مواد اولية +تغليف+ منتج جاهز
الزبائن	1320000.00	مبيعات آجلة(15 يوم)
الموردون	313468.00	اجل قصير(5ايام)

الحساب النهائي:

BFR=578480.00+1320000.00-313468.00=1585012.00 da

2-خطة الخزينة:

الرصيد التراكمي	صافي التدفقات	مصاريف التشغيل	مداخيل المبيعات	الشهر
+759192.00	+759192.00	1880808.00	2640000.00	شهر1
+1518384.00	+759192.00	1880808.00	2640000.00	شهر2
+2227576.00	+759192.00	1880808.00	2640000.00	شهر3
+3036768.00	+759192.00	1880808.00	2640000.00	شهر4
+3795960.00	+759192.00	1880808.00	2640000.00	شهر5
+4555152.00	+759192.00	1880808.00	2640000.00	شهر6
+5314344.00	+759192.00	1880808.00	2640000.00	شهر7
+6073536.00	+759192.00	1880808.00	2640000.00	شهر8

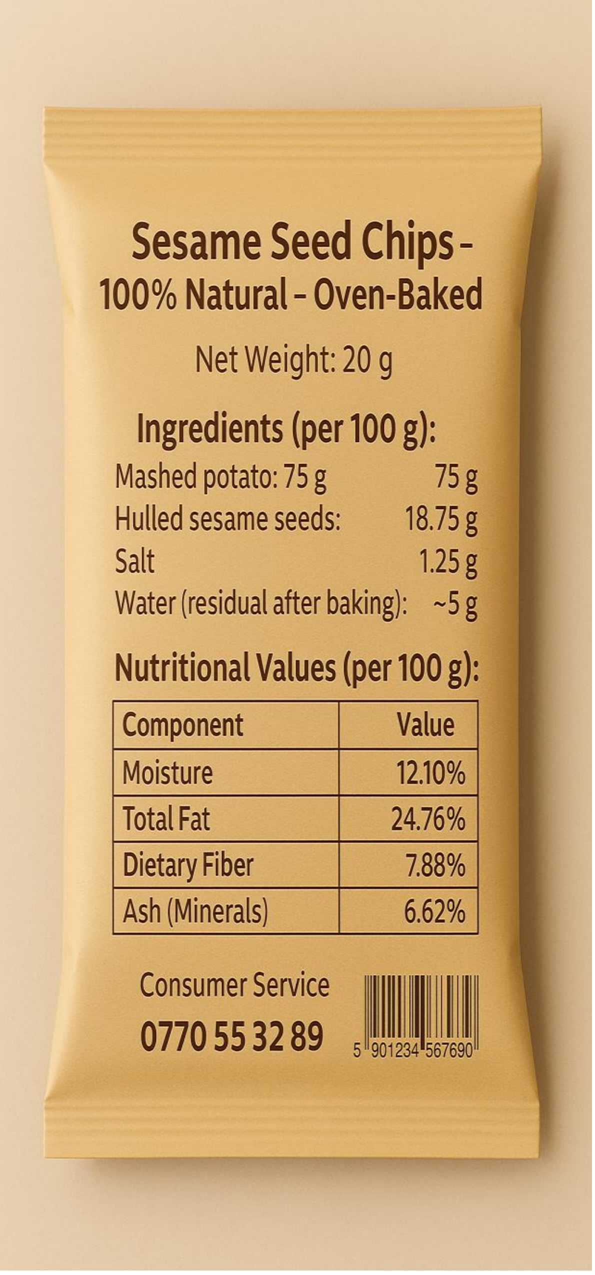
شهر9	2640000.00	1880808.00	+759192.00	+6832728.00
شهر10	2640000.00	1880808.00	+759192.00	+7591920.00
شهر11	2640000.00	1880808.00	+759192.00	+8351112.00
شهر12	2640000.00	1880808.00	+759192.00	+9110304.00

المحور السادس:

النموذج الاولي   التجريبي

المحور السادس: النموذج الاولي التجريبي

نموذج تجريبي لشيبس بذور اليقطين



نموذج تجريبي لشيبس بذور السمسم

قائمة الملاحق

نموذج العمل التجاري:

شريحة العملاء :

الاطفال /

الاباء الذين يبحثون عن بدائل صحية لهم و لاطفالهم

/المرضى و الاشخاص الذين يتبعون حمية غذائية/

الرياضيين

العلاقات مع العملاء :

- خدمةمابعد البيع

-توفير عروض خاصة للشراء بالجملة

-توصيل مباشر للعملاء الرئسيين

-تفاعل دائم عبر السوشل ميديا

القنوات :

بيع مباشر لتجار الجملة

-محالات الصغيرة و المتوسطة

-عبر انترنت

-تعاون مع النوادي الرياضية و الصيدليات و اطباء التغذية

قيمة مقترحة :

-شيبس صحي

-مكونات طبيعية

-جودة مضمونة

-دعم صحي

-طعم مميز و مختلف

الانشطة الرئيسية :

-شراء المواد الاولية (بطاطا/بذور / ملح)

-امراحل الانتاج (تفوير /تحميص / طحن / خبز)

-مراقبة ا لجودة

-التعبئة والتغليف و التخزين

-النقل و التوزيع و التسويق

موارد الرئيسة :

-الات الانتاج / تجهيزات المخبر /وحدة تصفية المياه /فريق الانتاج /شبكة الموردين للمواد الاولية

الشراكات الرئيسية :

الموزعين

الموريدين بالمادة الاولية و العتاد الصناعي

مصادر الايرادات :

بيع مباشر للشيبس بالجملة بسعر 30 دج /علبة

هيكل التكاليف :

ايجار الموقع 40000.00 دج

-الميزانية : التسويق و الاتصال (اعلان تلفزيوني/ مجتمع /ادارة)

-الموارد البشرية (قيمة الربح من البيع)

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

وزارة اقتصاد المعرفة والمؤسسات الناشئة والمؤسسات المصغرة

NESDA

جامعة 8 ماي 1945 - قالمة -

الوكالة الوطنية لدعم وتنمية المقاولاتية

الرقم: 229/ 24/CDE-UGU

CDF

شهادة تكوين في المقاولاتية

سلمت هذه الشهادة الى السيـد (ة): براهيمي مريم الحامل (ة) للرقم التعريفي الوطني الوحيد: 110020841007880008

إثباتا لمتابعته (ها) للدورة التكوينية في المقاولاتية وإنشاء المؤسسات المصغرة، المنظمة خلال الفترة الممتدة من:2025/05/11الى:2025/05/29

حرر بقالمة في: 2025/05/29

مدير المؤسسة الجامعية

عن المدير العام للوكالة الوطنية لدعم وتنمية المقاولاتية

مدير الجامعة

الأستاذ الدكتور: صالح العقون

المكلف بتسيير شؤون الوكالة الولائية لدعم وتنمية المقاولاتية قالمة

ع. بوسليط

NESDA

حررت هذه الشهادة للاستعمالها في إطار القرار الصادر عن وزير اقتصاد المعرفة والمؤسسات الناشئة والمؤسسات المصغرة المؤرخ في 29 رجب عام 1444 الموافق 20 فبراير سنة 2023، يحدد تنظيم وسير لجنة انتقاء واعتماد وتمويل المشاريع الاستثمارية المحدثة على مستوى الوكالة الوطنية لدعم وتنمية المقاولاتية وكذا كيفيات معالجة ومضمون الملفات المتعلقة بهذه المشاريع.

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

وزارة اقتصاد المعرفة والمؤسسات الناشئة والمؤسسات المصغرة

NESDA

جامعة 8 ماي 1945 - قالمة -

الوكالة الوطنية لدعم وتنمية المقاولاتية

الرقم: 228/ 24/CDE-UGU

شهادة تكوين في المقاولاتية

سلمت هذه الشهادة الى السيـد (ة): كعور شروق الحامل (ة) للرقم التعريفي الوطني الوحيد: 110030853001080004

إثباتا لمتابعته (ها) للدورة التكوينية في المقاولاتية وإنشاء المؤسسات المصغرة، المنظمة خلال الفترة الممتدة من:2025/05/11الى:2025/05/29

حرر بقالمة في: 2025/05/29

مدير المؤسسة الجامعية

عن المدير العام للوكالة الوطنية لدعم وتنمية المقاولاتية

مدير الجامعة

الأستاذ الدكتور: صالح العقون

مكلف بتسيير شؤون الوكالة الولائية لدعم وتنمية المقاولاتية قالمة

ع. بومليط

حررت هذه الشهادة للاستعمالها في إطار القرار الصادر عن وزير اقتصاد المعرفة والمؤسسات الناشئة والمؤسسات المصغرة المؤرخ في 29 رجب عام 1444 الموافق 20 فبراير سنة 2023، يحدد تنظيم وسير لجنة انتقاء واعتماد وتمويل المشاريع الاستثمارية المحدثة على مستوى الوكالة الوطنية لدعم وتنمية المقاولاتية وكذا كيفيات معالجة ومضمون الملفات المتعلقة بهذه المشاريع.