

Craterization and valorization of fresh *Allium ursinum* L bulbs in a food matrix

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ABSTRACT/RESUME

Abstract: The aim of this project is to develop and exploit a local medicinal plant, *Allium ursinum* L, and to measure its main compounds, such as phenolics, as well as studying its antioxidant effectiveness. Fresh bulbs from the plant were used as an additive in traditional mayonnaise to improve its quality. The results of the physicochemical analyses and assessment of the antioxidant activity of *Allium ursinum* L, show that the plant has significant levels of polyphenols 0.023 ± 0.02 mg GA equivalent/g, flavonoids 0.5 ± 0.03 mg quercetin equivalent/g, and carotenoids $5.6.10^{-5} \pm 0.02$ μ g/g. This wealth of bioactive compounds gives the plant a very high antioxidant activity of around 92%. This plant also contains 4.5% dietary fibre, with 5.13 mg BSA equivalent/g protein. The mayonnaise enriched with wild garlic had the highest moisture content at $20.5\% \pm 0.0.7$. In addition, when stored at room temperature, the pH fell from 4.62 to 4.08 in all the preparations, and the fat content fell in the enriched mayonnaise (49.86%). The results of the microbiological analyses showed that the aerobic germs at 30°C decreased in the enriched mayonnaise compared with the control. This is due to the antibacterial effect of the plant, and the results obtained in this study indicate that the incorporation of *Allium ursinum* L bulbs enriches the quality of traditional mayonnaise.

Keywords: *Allium ursinum* L, bulbs, incorporation, Mayonnaise.

I. Introduction

Nature, with its countless varieties of plants, is considered a treasure trove of primary materials used in medical technology.

primary used in medical technology, and plant-based preparations, the latter is known as alternative or complementary medicine. [1]

The increase in the use of plants has encouraged scientists to study the benefits of these plants, their geographical distribution, their plant division and the impact of environmental factors on them, as well as cultivation methods. In addition, research is focusing on active substances and antioxidants, their proportions and how to obtain them from plants for safe processing [2].

Amaryllidaceae are monocotyledonous medicinal plants with a single cotyledon. They are herbaceous, perennial and bulbous plants. There are more than 1,700 species, of which the *Allium* genus is the largest, with around 750 species. Many species are used as ornamental plants and others are used in food, such as garlic [3].

The allium genus is also used for its medicinal and culinary properties. interest has led to a number of experimental studies on this genus, which has specific physiological characteristics. [4]. *Allium Ursinum* L is a medicinal species recommended in traditional medicine for its therapeutic properties. for its therapeutic properties that resembles garlic [1]. It has been included in folk medicine as a digestive antimicrobial agent and

protector against cardiovascular disease and respiratory problems. Research has confirmed its anticancer, anti-inflammatory, antiviral, antiplatelet and hypolipidaemic effects. hypolipidaemic effects. [5, 6, 7]

Wild garlic or *Allium ursinum* belongs to the allium genus, which has a number of advantages All parts of the plant are edible. [8]

The objective of this study is to highlight the antioxidant properties of wild garlic from the Tikedjda region, and to assess certain quality criteria for a traditional mayonnaise enriched by using different proportions of wild garlic.

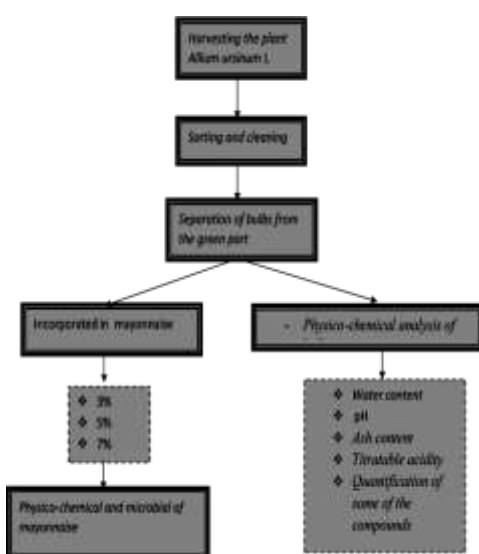
2. Materials and methods

2.1. Presentation of the plant material

The *Allium ursinum* L (Figure 1) used in this study was harvested during March 2021 in the Tikedjda region of Bouira (Algeria), in the form of fresh bulbs stored in a refrigerator at 4°C.



Fig.1. The *Allium ursinum* plant during harvesting.



2.2. Experimental protocol

Figure 2 shows a summary diagram of the stages involved in preparing plant materials as well as the experimental methodology.

Fig.2. Experimental protocol for characterising *Allium ursinum* L and its incorporation into mayonnaise.

2.3 Physico-chemical characterisation of *Allium ursinum* L bulbs

The water content (NF T60 305, June), pH (NF V 05-108, 1970), titratable acidity (NF V 05-101, 1974) and ash (NF V 05-113, 1972) of fresh *Allium ursinum* L bulbs were determined.

2.4. determination of phenolic compounds

a. Preparation of extracts

Ethanol extracts are prepared by macerating 1 g of fresh *Allium ursinum* L bulbs in 20 ml of 70% Ethanol. After shaking for 40 min, the mixture is then filtered and the filtrate stored at 4°C until use [9];

b. Determination of total polyphenol content

Total polyphenols were determined in the ethanolic extract using the method described in the literature [10, 11]

5 ml of distilled water was added to 0.5 ml of fresh *Allium ursinum* L bulb extract and mixed well; 0.5 ml of folin-ciocalteus reagent was added and left to stand for 3 min. Add 0.5 ml sodium carbonate (10%), mix well and incubate for one hour at room temperature in the dark, then measure the absorbance at 760 nm.

The calibration curve ($Y=aX+ b$) is obtained with gallic acid at different concentrations under the same operating conditions as the samples used to quantify the polyphenols.

c. Determination of flavonoid content

The estimation of the total flavonoid content in the Ethanolic extracts of waste or pumpkin pulp is carried out using the method described in the literature [12].

To a volume of 1ml of fresh *Allium ursinum* L bulb extract is added 1ml of aluminium chloride (2% $AlCl_3$) and the absorbance was measured at 430nm after 1 hour incubation. The quantity of flavonoids was calculated in mg quercetin equivalent per 1 g of sample (mg EQ / g Ech), based on the standard curve prepared with quercetin. The calibration curve ($Y=aX+ b$) obtained with quercetin at different concentrations under the same operating conditions as the samples will be used for flavonoid quantification. flavonoids.

d. Evaluation of antioxidant activity

The antioxidant activity of ethanolic extracts of pumpkin waste and pulp is assessed by the DPPH radical free radical scavenging activity. According to [13], the effectiveness of an antioxidant is measured by measuring the decrease in the purple colour and the turn towards yellow, due to recombination of DPPH radicals, by spectrophotometry at a wavelength varying between 515-518 nm.

The disadvantage of this method is its sensitivity to light. For this reason, the reaction must be carried out in the dark [14].

2ml of ethanolic DPPH solution (0.1 mM) is added to 50 µl of extract solution and standard, then the tubes are incubated at room temperature and in the dark for 30 minutes. Readings were taken at 517 nm.

Expression of results

DPPH radical inhibition % = $[(A_C - A_E)/A_C] \times 100$

Thus :

- A_C : Control absorbance.
- A_E : Sample absorbance.

2.5. Determination of total carotenoid content

The extraction of carotenoids from complex biological matrices is a delicate yet crucial stage in the qualitative and quantitative study of carotenoids. The quantities extracted are often of the order of only a few tens of micrograms per gram of dry matter [15].

Quantification of total carotenoid content is based on the method of [16] with some modifications. 0.5 g of fresh *Allium ursinum* L bulbs were weighed into a flask to which 5ml of previously prepared hexane-acetone-ethanol mixture (v/v/v;50:25:25) was added prepared, then vortexed at 200 rpm at room temperature and centrifuged at centrifuged at 6500 rpm for 5 min at 4°C. The supernatant is recovered to which 5 ml of extraction solvent is added, and the reading is taken at 450 nm.

Expression of results

$C(\mu\text{g/g}) = \text{Abs}_{450} \text{Fd. } 106 \cdot V/345 \cdot 100 \cdot P$

Thus :

- Fd: is the dilution factor,
- V : is the volume of extraction solvent,
- 3450 : is the hexane extinction coefficient,
- P: is the weight of the test sample.

2.6. Preparation of mayonnaise samples

In order to study the influence of the *Allium ursinum* L type on the physicochemical and microbiological properties and the organoleptic quality of the mayonnaise, it was manufactured on a traditional scale using different percentages of *Allium ursinum* L (3, 5.7%). The ingredients used to obtain the experimental samples of mayonnaise were as follows: commercial oil (73%), egg yolk (10%), mustard (8%), vinegar (5%), cooking salt (2%) and black pepper (0.5%). All the food ingredients used were of good quality. The mayonnaise samples obtained were placed in glass food and transported to the laboratory in a cool box. Sensory were carried out on all the samples of mayonnaise that had been kept for for 3 days at a temperature of 6°C. The prepared mayonnaise underwent physico-chemical, microbiological and organoleptic.

3. Results and discussion

3.1 Results of physico-chemical analyses of *Allium ursinum* L. bulbs

The results of physico-chemical analyses of fresh *Allium ursinum* L. bulbs are summarised in the table below. in the table below:

sample	Water content (%)	ash (%)	PH	Acidity Titrable (%)
<i>Allium ursinum</i> L	83,15±0,8	0,64	6,86±0,08	0,7

Table 1: Results of physico-chemical analyses of *Allium ursinum* L. bulbs.

a. Moisture content

Moisture or water content is the quantity of water in a sample (ISO 662, 1998) and varies according to the species and organ under consideration [17].

Most plants are rich in water, with fresh plants containing around 60 to 80% water of water [18]. The water content of *Allium ursinum* L bulbs is 83.15±0.8%, a relatively high value. However, the dry matter content is only 16.85±0.8.

Other experimental studies on wild garlic, ordinary garlic and red onions showed a slight difference in the results. According to [19, 20, 21]; the water content of *Allium ursinum* L reaches 91.74% which is higher than what we found. However, our result is close to that found in red onions.

On the other hand, ordinary garlic contains 60 to 65% of water, so we conclude that there is a

convergence (similarity) in the results between red onions and *Allium ursinum* L. This can be explained by the structural and biochemical similarity between these two plants. On the other hand, the slight difference in the rest of the allium plants is due to the part treated and the time and place of harvesting.

According to the results found in comparison with the literature, wild garlic bulbs can be classified, from the point of view of water content, in the group of vegetables and plants known to be rich in water [22].

b. Ash content

The ash content provides information about the mineral salt content. The ash content of *Allium ursinum* L. of *Allium ursinum* L., is equal to 0.64%, this value is lower than that found by [23] who worked on garlic and leek and found values of 1.42% and 0.86% respectively. respectively and it is higher than that of onion (0.59%), unlike the leaves they are richer in minerals with an ash content of around 2.24 found by [19].

Variations in mineral matter content (ash content) are most likely due to growing conditions such as temperature and humidity. due to growing conditions such as soil quality (distribution of mineral elements in the soil) elements in the soil), the volume of water and the composition of the fertilisers used [24].

c. Hydrogen potential

The pH or hydrogen potential is a variable that represents the measure of alkalinity in chemistry, so the degree of acidity or basicity of a solution or finished product for quality control purposes.

According to the pH results obtained using a pH meter, we noted that the pH of *Allium ursinum* L. bulbs is 6.86 ± 0.08 , which means that our plant has an almost neutral pH, as described [25].

d. Titratable acidity

Acidity is a measure of the total concentration of acid. In titration with a base, all H⁺ ions are neutralised, whether ionised or not. Acidity is closely linked to the biochemical composition of the plant. The titratable acidity of the *Allium ursinum* L. plant is 0.7%.

3.2. Quantification of some of the main compounds in *Allium ursinum* L

a. Total polyphenol content (TPP)

The PPT value of *Allium ursinum* L. bulbs is of the order of 0.23 mg EAG /g, other experimental studies

(table 02) show that total polyphenols in the allium genus vary from 0.02 to 5-15 mg EAG/g. Our results are in line with previous studies on *Allium ursinum* and *Allium porrum* carried out by [8] and [1] which are equal to 0.052; 0.38mg EAG/g respectively. On the other hand [19], who worked on *Allium triquetrum* found a value higher than lanotre (3.20mg EAG/g), as did [6] who studied the phytochemical and pharmacological properties of *Allium ursinum* (2.30mg EAG/g).

In comparison with the research by ouedraogo et al. (2015), the PPT of onion (*Allium cepa* L) grown in the central north region of Burkina Faso is 0.195 mg EAG/g, a value close to that of *Allium ursinum* L. (0.23 mg EAG/g). Furthermore, according to [1], the leaves have a higher value than the bulbs of *Allium ursinum*, equal to 3.07 mg EAG/g.

According to the literature, the results of quantitative analyses of the PPT of *Allium ursinum* L. show a variation which may be due to the part, the geographical origin and the time of harvest of the plant, or because of colorimetric determination by the Folin reagent which is sensitive to the reduction of hydroxyl groups, or depends on the extraction method and solvent.

Table 02: Results of PPT content in other experimental studies. Experimental studies.

	Content of PPT (mg /g)	Référence
<i>Allium ursinum</i> L.	2,30	[6]
<i>Allium sativum</i>	0,18	[27]
Poireau (30 cultivars)	5-15	[28]
<i>Allium triquetrum</i>	3,204	[19]
<i>Allium ursinum</i> L.	0,052	[8]
<i>Allium ursinum</i> L.	0,38,	[29]
<i>Allium cepa</i> L.	0,195	[26]

b. Flavonoid content

Allium ursinum bulbs were found to contain 0.06 mg EQ/g of flavonoids. In fact, [8, 1] revealed contents of 0.02 ;0.035 mg EQ/g respectively lower than our bulbs studied.[19] reported results higher than ours concerning flavonoids in *Allium ursinum* bulbs (1.66 mg EQ/g).

Another study found different results to ours and indicated that the flavonoid content of *Allium ursinum* bulbs was higher than ours. and indicated that the flavonoid content of garlic and leek bulbs (0.12, 0.1 mg EQ/g) respectively, are higher than those of the *Allium ursinum* L. bulbs studied.

c. Carotenoid content

Allium ursinum L. bulbs show a value equal to 5.6×10^{-5} mg/g, while the leaves show significant values, with carotenoid content reaching up to 9.9 ± 0.01 mg/g recorded by [6].

From the results obtained and their comparison with previous studies, we deduce that the carotenoid content varies quantitatively and qualitatively from one part to another on the same plant. to another on the same plant, which can be attributed to several factors:

- Climatic and environmental factors: geographical area, drought, soil, Diseases. [30]
- Harvest period and ripening stage of the plant [31]
- The extraction method [16].

d. Anti-radical activity against the DPPH radical

The *Allium ursinum* L plant has very high antioxidant activity (92.75%), as do the scavenging activities of fresh bulbs extracted by decoction and infusion studied by [1], which vary between 32.06% and 66.61% respectively.

The antioxidant activity study revealed that the ethanolic extract of *Allium ursinum* L exerted a high activity, in contrast to the extraction method by decoction and infusion infusion method described by [1] showed low activity, which means that the extraction extraction method can influence antioxidant activity.

3.3. Fibre content

Dietary fibre is a member of the carbohydrate family. They are polysaccharides with They are more or less long chain polysaccharides that humans do not digest.

According to the results obtained, our *Allium ursinum* L bulbs contain 4.5% dietary fibre. dietary fibre. [23] reported values of 2.31% for garlic, 1.81% for onions and 2.27% for leeks. These values are lower than those for *Allium ursinum* L, which means that our plant is rich in fibre. our plant is rich in fibre.

3.4 . Protein content

The *Allium ursinum* L plant has a protein content of around 5.13 mg EBSA/g. It has been reported by [6] and [32] that the protein content of *Allium ursinum* L bulbs equals 2.61 - 3.67mg/g. These values are lower than those found in our study, which can be explained by the difference in harvesting region and period as well as the degree of ripening.

On the other hand, the study carried out by [23] showed that there was a difference in the results for onions (1.25 EBSA/g), garlic (6.05 EBSA/g) and leeks (2.24 EBSA/g) compared to our plant, ordinary garlic contains the highest protein value, estimated at estimated at 6.05mg/g. Onions and leeks, on the other hand, have protein contents lower than those of *Allium ursinum* L and this difference in results may be due to the difference in plant type. type of plant.

3.5. Physico-chemical analysis of mayonnaise

This section is devoted to the results and discussion of the physico-chemical, microbiological and sensory analyses of our mayonnaise, the aim being to determine whether there has been any change in the physical, chemical and microbiological properties of the mayonnaise. from a physical, chemical and microbiological point of view after the incorporation of different proportions of the *Allium ursinum* L plant in a home-made mayonnaise, and also to which of the four products the tasters preferred.

The physicochemical analyses of the Mayonnaise are recorded in the table below:

Table 03: Results of physicochemical analyses of the Mayonnaise

Sample	water(%)	asch(%)	fat(%)
control	17,5 ± 0,42	0,589 ±0,014	72,365 ±0,007
3%	19,7 ± 0,42	0,579	61,87 ±0,014
5%	18,9 ± 0,99	0,79 ±0,014	51,48 ±0,028
7%	20,5 ±0,7	0,75 ±0,014	49,865 ±0,021

a. Water content

According to the results of (Table03), the water losses during drying of the Mayonnaise samples obtained vary between (17.5% - 20.5%), which comply with the standard (Codex STAN 168-1989).

In fact, we recorded higher water contents in the Mayonnaise enriched with wild garlic compared with the control. This increase may be due to the high water content of *Allium ursinum* L bulbs (83.15%). The study conducted by [33] showed that the water content of Mayonnaise enriched with different extracts (Oleastre, Lourier, Combination of the two extracts) varied between (37% - 43.8% - 54.8%). By comparing these values with the results obtained in our study, we can deduce that despite the high humidity recorded in the samples prepared with wild garlic wild garlic, but it remains more or less the same as that demonstrated by [33]

Knowing that the increase in water content favours the growth of certain microorganisms [34] but the use of the *Allium ursinum* L plant inhibits the growth of these microorganisms, as it has an antibacterial, antifungal and antiparasitic effect [6].

b. Ash content

According to the results shown in table 08, the ash content of the control was 0.58% and 0.57% to 0.79% for the other mayonnaises enriched with *Allium ursinum* L. This means that the mayonnaise enriched with *Allium ursinum* L bulbs is rich in organic matter (you are talking about organic matter or ash) and the latter comes from the organic matter present in the bulbs.

This means that mayonnaise enriched with *Allium ursinum* L bulbs is rich in organic matter (you are talking about organic matter or ash) and the latter is due to the organic matter present in the bulbs.

c. Fat content

All the samples analysed showed values between (49.86% and 72.37%) which comply with the standard (Codex STAN 168-1989).

It can be seen from the results that the percentage of fat in the Mayonnaise is very high compared to that prepared with wild garlic, but the lowest fat content is found in the fat content was recorded in the Mayonnaise enriched with 7g of *Allium ursinum* L (49.86%).

The lower fat content in the Mayonnaises enriched with *Allium ursinum* L by the fact that this plant has a high fibre content, and also contains also contains alliin and methine, active compounds that help to reduce the products of lipid peroxidation products and inhibits cholesterol biosynthesis[35];

d. Salt content (NaCl)

The results of salt content analyses are presented in table 4.

Table 04: Results for the salt content of mayonnaise.

Sample	Content of (NaCl) %
Control	0,77 ± 0,008
3%	0,76 ± 0,06
5%	0,83 ± 0,016
7%	0,73 ± 0,016

After measuring the salt content in the prepared mayonnaises, there was a high degree of convergence in the results (table 09), due to the use of the same amount of salt in all the preparations.

These results are similar to those of Codex STAN

168-1989 and mentioned 1.16% and 1% respectively. In addition, adding salt to mayonnaise helps to improve flavour and slow down the growth of micro-organisms, thus extending shelf life [36]

e. Hydrogen potential

Physicochemical measurements were carried out to study the behaviour of Mayonnaise in terms of pH during storage at room temperature. The results of monitoring results (Fig.3) are in the range 4.62 to 4.08 and do not lead to any considerable change during storage.

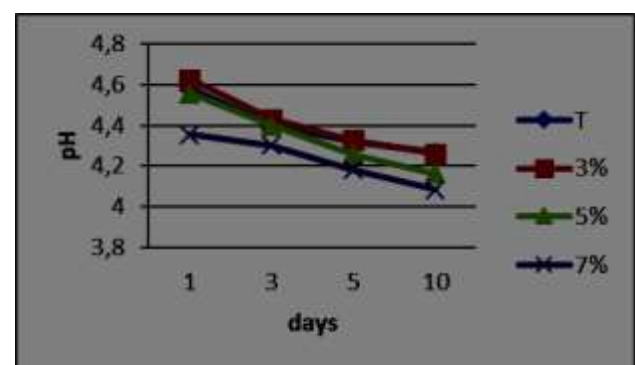


Fig. 3: Fall in pH values during storage at room temperature.

We note that during 10 days of storage the fall in pH values was less significant in the four types of mayonnaise prepared. On the other hand, the pH measured in literature fell from 3.9 to 3.5 after 15 days of storage at room temperature. .

microbiological analyses

The results of the microbiological analyses carried out on the four types of Mayonnaise are given in Table 10. These results show that the number of

aerobic germs at 30°C in the control Mayonnaise increased during cold storage to reach 26.103 CFU/g.

In addition, it was noted that during the first few days of storage of Mayonnaise enriched with wild garlic, there was initially an increase in the bacterial load but this decreased after a few days of storage. A slight decrease in the number of germs was observed at 30°C, which means that our *Allium ursinum* L plant has an antibacterial effect. The same observation was made by [19] ; [37] they concluded that bacterial strains especially staphylococci aureus, E.Coli, FTAM... are sensitive to allium extract.

As far as yeasts and moulds are concerned, in the first trials a large number were recorded, but in the last two trials the numbers of these bacteria decreased in all the mayonnaise preparations. This disturbance in the results may be due to contamination in the laboratory oven or to poor handling and the poor hygienic quality of the culture media used.

Microorganisms	Control	3%	5%	7%
Week 1				
Aerobic germs at 30°C	5,5.10 ²	7,4.10 ³	2,2.10 ⁴	2.10 ⁴
Yeasts	ND	6,3.10 ³	7, 3.10 ⁵	8.10 ⁵
Mould	ND	ND	1,4.10 ³	1,8.10 ³
Escherichia coli	ND	ND	ND	ND
Staphylococcus aureus coagulase	ND	ND	ND	ND
Salmonella	ABS	ABS	ABS	ABS
Week 2				
Aerobic germs at 30°C	2, 3.10 ³	1, 3.10 ⁴	5,5.10 ³	2,5.10 ³
Yeasts	1,4.10 ⁴	8,5.10 ⁴	6, 3.10 ³	2,7.10 ³
moulds	4,5.10 ³	9,1.10 ²	4,5.10 ²	3,6.10 ³
Escherichia coli	ND	ND	ND	ND
Staphylococcus aureus coagulase	ND	ND	ND	ND
Salmonella	ABS	ABS	ABS	ABS

	Week 3			
Aerobic germs at 30°C	2,7.10 ⁴	4,8.10 ³	5,9.10 ³	6, 3.10 ²
Yeasts	4,5.10 ³	7,7.10 ³	2,7.10 ³	9,1.10 ²
moulds	1,4.10 ⁴	4,5.10 ⁴	ND	4,5.10 ²
Escherichia coli	ND	ND	ND	ND
Staphylococcus aureus coagulase + Salmonella	ND	ND	ND	ND
	ABS	ABS	ABS	ABS

So, to reduce the risk of contamination, we recommend adding a small amount of wild garlic when preparing a traditional mayonnaise. when preparing a traditional mayonnaise, and it is preferable to accompany it with vinegar or mustard. with vinegar or mustard, and it should be kept at a low temperature. kept at a low temperature. (Ferial et al. 2008)

Conclusion

Our work is a contribution to the study of the physico-chemical properties of *Allium ursinum* L bulbs. *Allium ursinum* L bulbs is to test the incorporation of mustard at different doses into Mayonnaise.

In the light of the results obtained, the physico-chemical characteristics of the raw material revealed a moisture content of 83.15% and an ash content of 0.64%. The pH and acidity acidity value of around (6.86; 0.7%) means that our bulb is neutral to basic in nature.to basic.

The bulb of *Allium ursinum* L contains significant levels of polyphenols 0.023mgEAG /g, flavonoids 0.06mgEQ/g, carotenoids 5.6. 10⁻⁵ µg/g and a remarkable fibre content of remarkable fibre content of 4.5% and protein content of 5.13 mg BSA equivalent/g. In addition, the antioxidant power of the phenolic extract of the bulbs of

Allium ursinum L bulbs by the DPPH test, revealed that the compounds are excellent natural natural antioxidants and inhibit oxidation very effectively, by up to 92%.

These results show that the incorporation of *Allium ursinum* L bulb into mayonnaise improves its nutritional value as well as its shelf life.

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