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## EPIDEMIOLOGY, STRUCTURAL ANALYSIS AND INHIBITION STUDY OF URINARY LITHIASIS IN SOUTHWESTERN ALGERIA

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### Abstract:

Urinary lithiasis is an economic and social concern and a common pathology that affects the urinary system and causes renal failure in 45% of cases. As a result, epidemiological data analysis is critical for better understanding the evolution of the lithiasis disease and its relationship to the pathologies or risk factors involved in its development.

This work is divided into three sections. The first section is devoted to a 10-year retrospective epidemiological study and aims to study the epidemiological profile of urinary lithiasis and determine the disease's evolutionary trend over time. The second component is an epidemiological study of 100 urinary stones collected from hospitals and private clinics in South Western Algeria. Furthermore, a study of the role of epidemiological risk factors such as age, gender, and anatomical localization in the process of stone formation is carried out. It is then followed by a morpho-constitutional analysis of urinary stones and an infrared spectrophotometric analysis to confirm the type of lithiasis studied. The third section is a phytotherapeutic investigation. The first part summarizes the natural inhibitors for treating urinary lithiasis. The second part investigates plants' in vitro dissolving effect on calcium oxalate monohydrate (Whewellite) stones. In the third part, an in vitro study of the effects of aqueous extracts of some medicinal plants on Oxalo-calcic crystallizations.

**Keywords:** Urinary lithiasis, Epidemiology, Calcium oxalate crystallization, Medicinal plants, Inhibition, Fourier Transform Infrared Spectroscopy

## **Introduction**

Urinary lithiasis is a common pathology <sup>[1]</sup>, and several epidemiological studies have revealed an increase in the prevalence of lithiasis in developed countries <sup>[2]</sup>. It is a significant public health issue. This disease's prevalence has increased over the last few decades <sup>[3]</sup>, closely related to changes in sanitary conditions, eating habits, and the population's standard of living. It primarily affects young adults, with a peak in frequency at 40. A slightMen predominance exists. Urinary lithiasis has a significant economic and clinical impact. Lithiasis disease has been linked to 4% of all end-stage renal failure cases requiring hemodialysis <sup>[4]</sup>. Calcium oxalate lithiasis accounts for 80-85% of lithiasis in the urinary tract <sup>[5]</sup>.

This study focuses on calcium oxalate lithiasis because calcium oxalate is not only the main component of the majority of stones but also the most common crystalline species in urine<sup>[6]</sup>. Different surgical techniques have been developed, and extracorporeal lithotripsy (ECL) has largely replaced open surgery. The latter has transformed urological practice and is now the standard method for removing urinary stones. Despite the advancement of new technologies for treating urinary stones, these treatments are frequently prohibitively expensive, poorly tolerated, and have side effects that are either harmful or ineffective for the patient's health. This is the case with LEC, which does not always produce the expected results, and it is difficult to remove the fragments of a badly broken stone, even though residual fragments are one of the primary causes of lithiasis recurrence<sup>[7]</sup>.

## **Material and Methods:**

### **Patients and Methods:**

This retrospective study entails a census of all lithiasis patients treated in the public urology service of the willaya of Bechar in Southwestern Algeria from 20017 to 2024. The information was gathered from the registers of the urological surgery service at Ahmed Torabi Hospital in Bechar. This study focuses on patients who have had urinary lithiasis surgery. This study includes patients of both sexes and all ages with a first or recurring episode of urinary stones, regardless of the stone's anatomical location. Patients who underwent diagnostic procedures and those whose stones were removed by extracorporeal lithotripsy (ECL) were excluded.

### **Epidemiology of urinary stones:**

This retrospective study also concerns a census of all lithiasis patients treated in the public urology service of the willaya of Bechar in Southwestern Algeria between 2017 and 2024. The information was gathered from the registers. The services in question are the urological surgery services of the Ahmed Torabi Hospital in Bechar and the private hospital's urological surgery service.

### **Study of the inhibitory effect of aqueous plant extracts on the dissolution of calcium oxalate stones (in vitro):**

We prepared an extract of each plant by infusing 6 g of dry plant in 100 ml of boiling physiological solution (9 g NaCl per liter) for 30 minutes, with the 9 g/L NaCl solution serving as a control medium to assess changes in stone mass and/or structure.

**Study of the effect of aqueous plant extracts on the crystallization of calcium oxalate monohydrate (in vitro):**

**Plant extraction:**

The plant material's aerial part was collected, air-dried, and ground to powder. An aqueous extract was made by infusing 30 g of each plant's powder in 500 mL of distilled water and bringing it to a boil for 30 minutes (Reflux Extraction). Extracted plant extracts were recovered, filtered, and cooled before use. The plants were collected in the Becharwilaya region. In our study of the crystallization of Oxalo-calcic by the conductimetric model, we used a plant extract. This model includes the investigation of crystallization without and with inhibitors to quantify the effect of each natural substance studied's inhibition power. The crystallization filtrates were dried and analyzed using Fourier Transform Infrared (FTIR) spectroscopy in the absence and presence of plant extracts. We used Fourier Transform Infrared (FTIR) spectroscopy to confirm the type of crystals formed during the crystallization of our tests in the absence and presence of plant extracts.

**General description of the sample:**

This study included 758 lithiasis patients, with 67.02% men and 32.98% women, for a sex ratio of (2.03). The average age was between 30 and 40. The patients were divided into eight age groups, with most subjects between 31 and 50. The majority of stones were found in the upper urinary tract (66%) versus 34% in the lower tract. The right side dominated with a frequency of 63% compared to 37% for the left side.

**Table 1:** General description of the study population.

	Number	Frequency(%)
Patients	758	
Man	508	67%
Woman	250	33%
Stone location		
Uperurinary tract	500	66%
Lowerurinary tract	258	34%
Stones position		
Right Kidney	478	63%
Leftkidney	280	37%

**Distribution of lithiasis subjects:**

The epidemiology of urinary lithiasis in patients from the southwestern region of Algeria shows a slight predominance of lithiasis in men, as observed in other countries. It can be noted that the most frequent period of lithiasis subject is between 2016 and 2020, and the frequency was more important than the other years for both sexes in 2018.

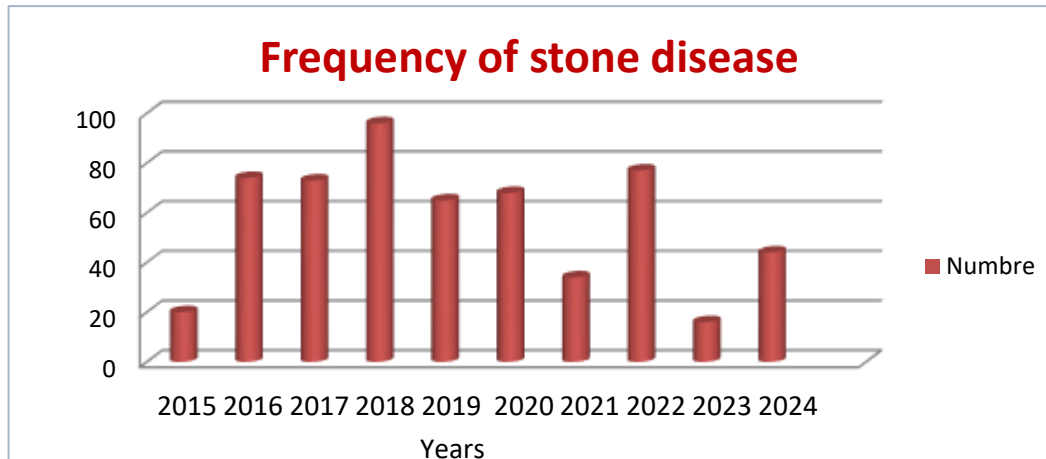


Figure 1: Evolution of urinary lithiasis at the Ahmed Torabi Hospital.

**Sex influence:**

The distribution of stones varies greatly depending on the patient’s sex. The man preponderance of lithiasis, which was overwhelming in previous centuries, has significantly decreased<sup>[8]</sup>. Looking at the results in Table 1, it is clear that men outnumber women in the distribution of lithiasis patients, with a sex ratio of (2.03). During the years of our study, the frequency of lithiasis was exchangeable between the sexes, according to Our findings

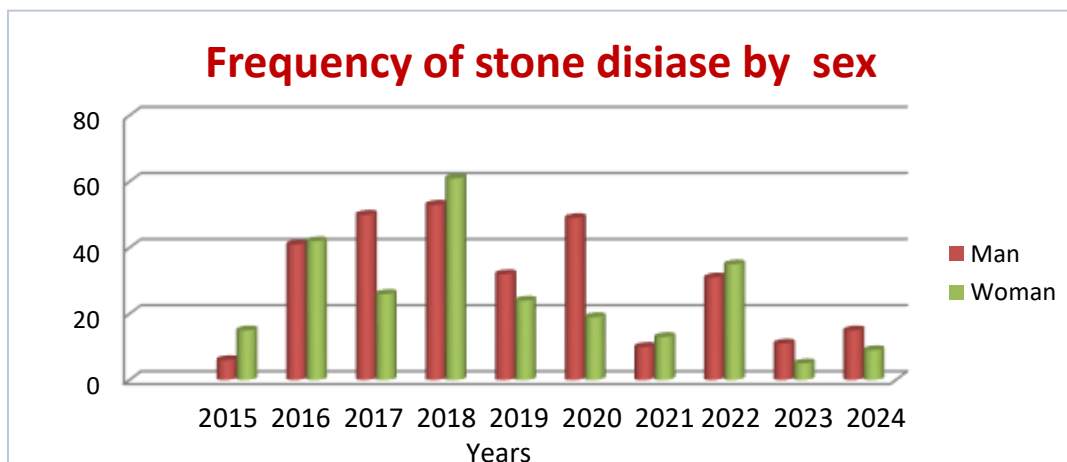


Figure 2: Evolution of urinary lithiasis according to the period.

**Age influence:**

Another important consideration is the patient’s age<sup>[9]</sup>. Indeed, certain types of stones are more common in certain age groups, reflecting a change in lithogenic risk factors throughout life based on factors such as nutritional habits, infection exposure, and renal function. The findings, summarized in Figure 5, show that 56.6% of the lithiasis patients were between 30 and 50. Furthermore, the most common age group for lithiasis in both sexes is between 40 and 50.

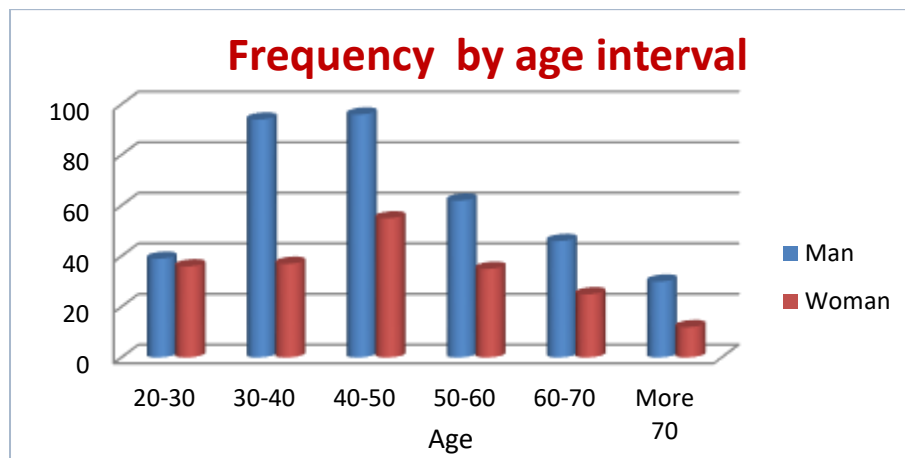


Figure 3: Evolution of urinary lithiasis according to age and sex.

**Stones’ location:**

**Distribution of urinary stones according to location:**

The majority of stones are found in the upper urinary tract (66% versus 34% in the lower tract). These findings are consistent with those of Djelloul et al. <sup>[10]</sup>. With a percentage of 77.4%, the stones are anatomically located in the upper urinary tract. In contrast to the findings in the western region, Harrache et al. reported a high prevalence of bladder lithiasis in adults (45.5% men)<sup>[11]</sup>.

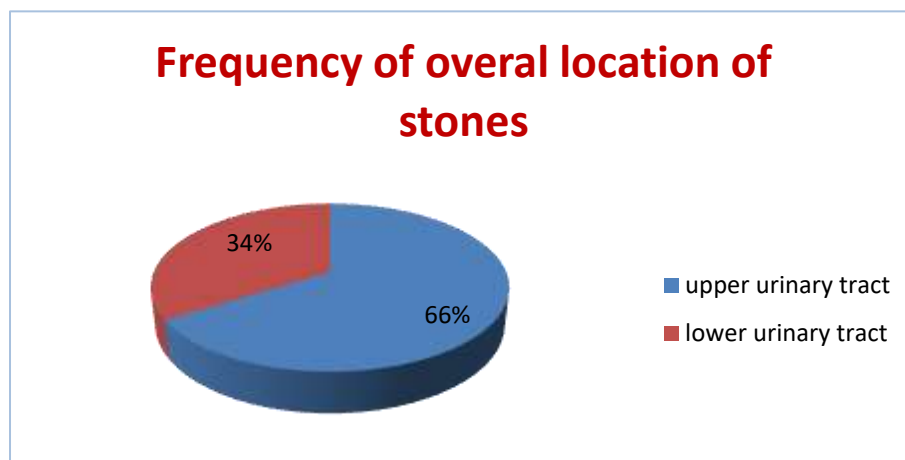


Figure 4: Distribution of urinary stones according to location.

The results for the overall location of stones by sex show that this change in the location of stones over

time in the upper or lower urinary tract is only for males. In contrast, the upper urinary tract was always the preferred location in women, regardless of the period.

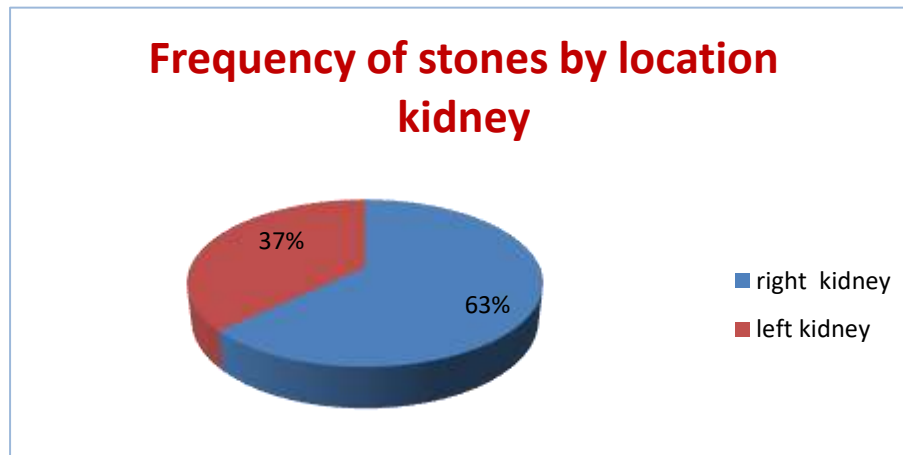


Figure 5 :The distribution of urinary stones according to the location of the right or left kidney.

#### **Distribution of urinary stones according to the location of the right or left kidney:**

According to our findings, most stones are lodged on the right side, with a frequency of 63% versus 37% on the left side. Regarding stone laterality, when we look at the data in the literature, which is often limited to a small series of stones, there is only a very small left or right preponderance in the studies. Takasaki in Japan, for example, found that 52.6% of 1060 upper apparatus stones came from the left side[12]. Djelloul et al. confirmed this preferential localization of stones on the left side in a study of 1354 collected in Algeria (56.4% versus 42.5%;  $p < 0.001$ ) [10].

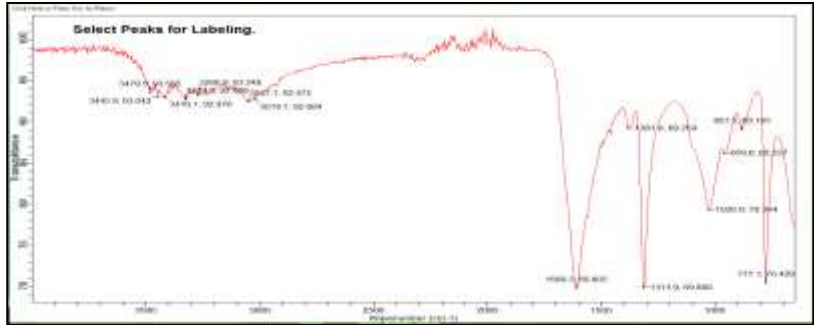
#### **Morpho-constitutional classification:**

Stones play an important role in the etiological diagnosis of lithiasis. It is practically the only source of information on lithogenesis conditions, growth factors, and recent or ancient lithiasis activity. The physician (general practitioner, urologist, or nephrologist) will be able to adapt the necessary dietary rules to avoid the recurrence of urinary stones based on the etiological interpretation of the results of the morpho-constitutional analysis of the stones. Our study included 100 surgically treated or spontaneously expelled stones from the Ahmed Torabi Hospital's urological surgery department and private services in the Wilaya of Bechar.

The Infrared spectrum of some stones collected in the urological surgery department of the Ahmed Torabi Hospital in Bechar: Figure 7-20 [17-34].

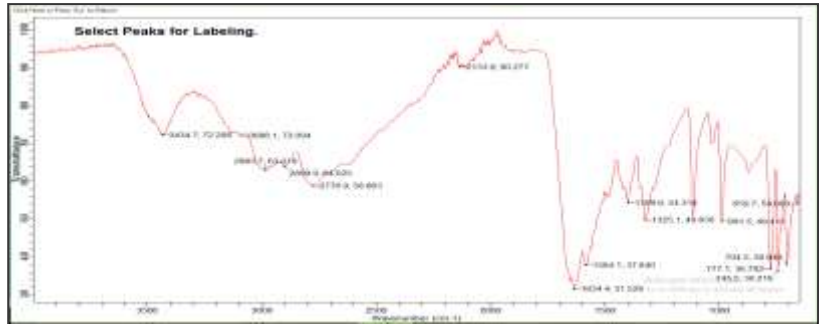
**Type of stones**

**Infrared spectra**



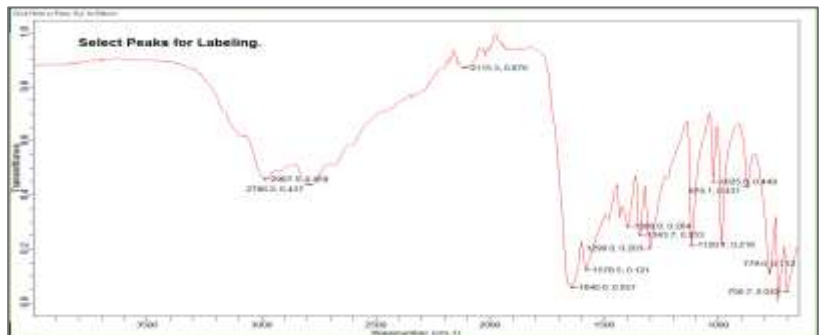
Whewellite +Carbapate.

*Figure07 :Infrared spectra of the central mass of a stone of majority Whewellite composition.*



Uric acid dihydrate

*Figure 08:Infrared spectra of the central mass of a stone with a majority composition of uric acid dihydrate*



Anhydrous uric acid.

*Figure09:Infrared spectra of the central mass of a stone of majority composition of anhydrous uric acid.*



Struvite

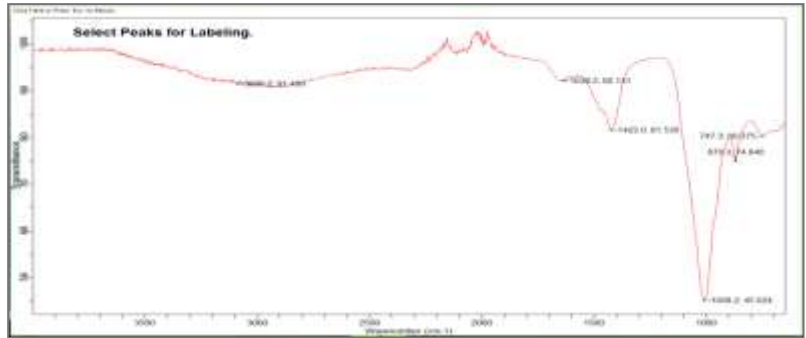


Figure 10: Infrared spectra of the central mass of a stone with a majority struvite composition.



Whewellite+Weddellite



Figure 11: Infrared spectra of the central mass of a stone with a majority whewellite composition



Whewellite + Weddellite

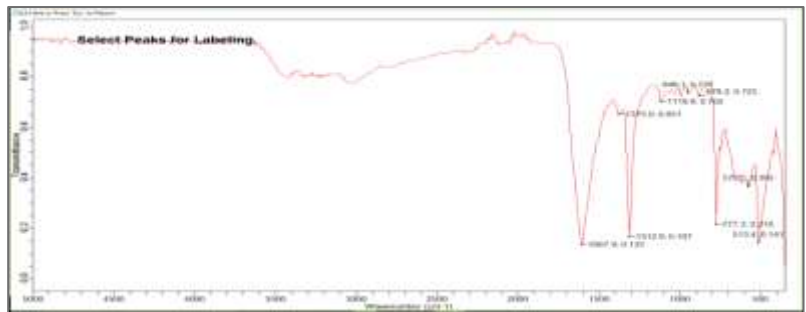


Figure 12: Infrared spectra of the central mass of a stone of majority Whewellite composition



Struvite

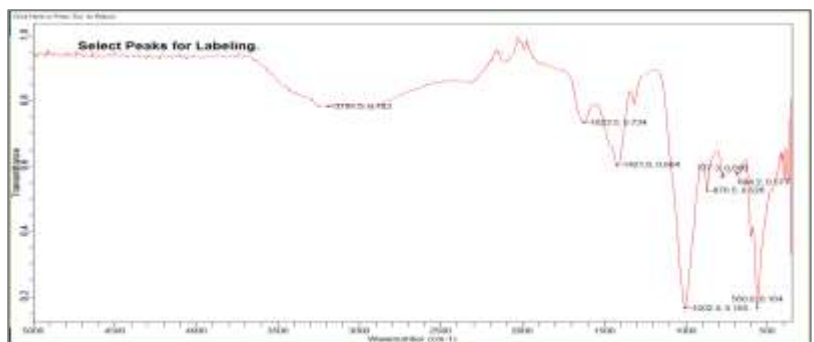


Figure 13: Infrared spectra of the central mass of a stone with a majority struvite composition



Whewellite +Carbapatite.

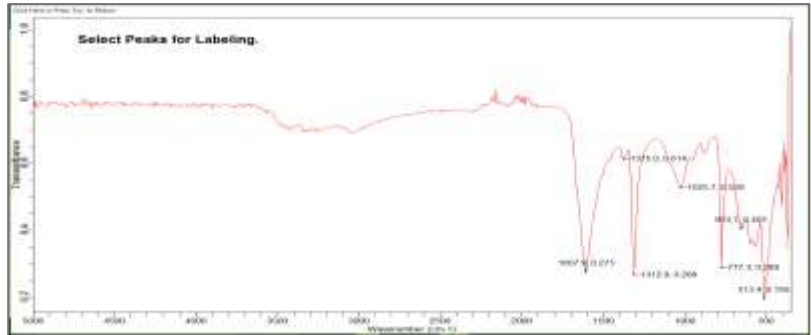


Figure 14: Infrared spectra of the central mass of a stone with a majority whewellite composition.



Whewellite +Carbapatite.

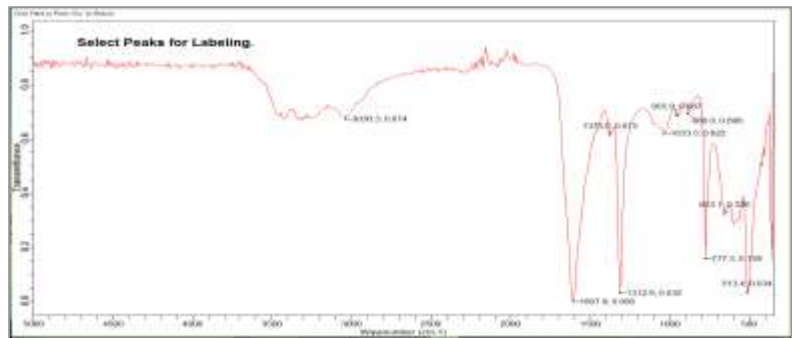


Figure 15: Infrared spectra of the central mass of a stone with a majority whewellite composition



Whewellite

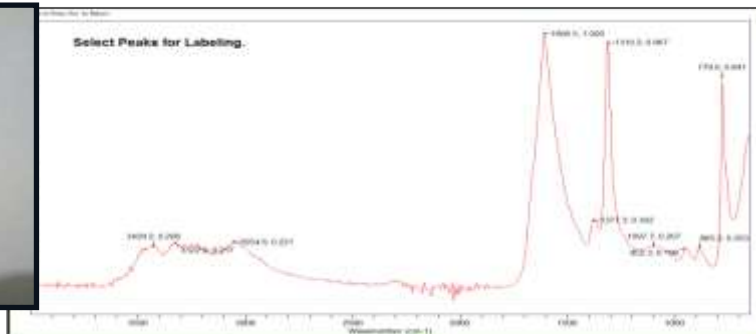


Figure 16: Infrared spectra of the central mass of a stone with a majority whewellite composition



Whewellite +Carbapatite.

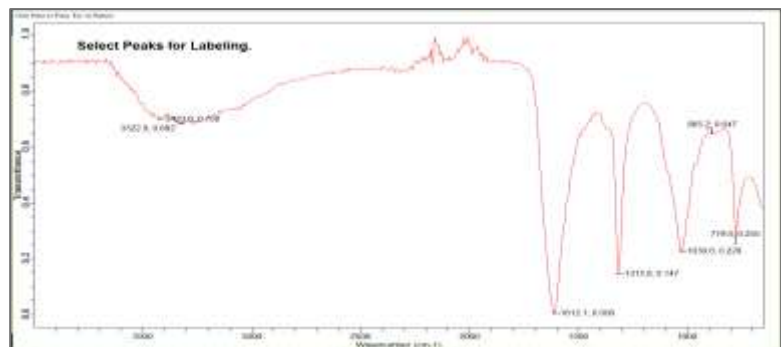


Figure 17: Infrared spectra of the central mass of a stone with a majority whewellite composition



Anhydrous uric acid.

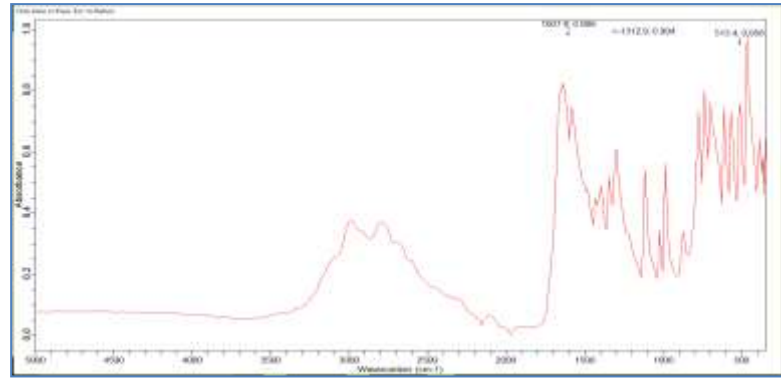


Figure 18: Infrared spectra of the central mass of a stone of majority composition of anhydrous uric acid.



.Calcite

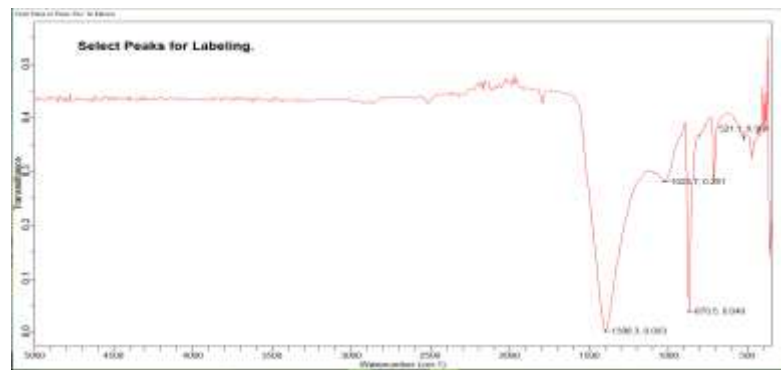


Figure 19: Infrared spectra of the central mass of a stone of majority calcite composition



Carbapatite +.Whewellite

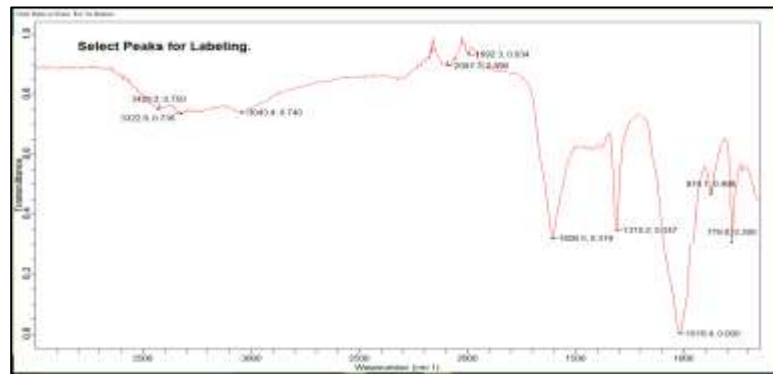


Figure 20: Infrared spectra of the central mass of a stone of majority carbapatite composition

**Table 2:** Characteristic Infrared Bands of Some Human Urinary Calculi.

Compounds	Bands (cm <sup>-1</sup> )	Reference
Whewellite	3434 <b>bw</b> , 3334 <b>bw</b> , 3049 <b>bw</b> , 1605 <b>is</b> ,1366 <b>iw</b> , 1310 <b>is</b> , 949 <b>w</b> , 885 <b>w</b> , 779 <b>is</b> , 540 <b>im</b> .	[24, 26,29,30, 33]
Carbapatite.	3400-3000 <b>bw</b> , 2111 <b>w</b> ,1419 <b>w</b> , 1037 <b>is</b> ,	[24, 26,29,30, 33]
Anhydrousuricacid	3400-2600 <b>bm</b> ,1694 <b>is</b> , 1640 <b>is</b> ,1593 <b>is</b> ,1541 <b>is</b> ,1432 <b>m</b> ,1346 <b>m</b> , 1120 <b>is</b> , 1025 <b>im</b> , 1005 <b>bw</b> ,874 <b>iw</b> ,779 <b>is</b> ,750 <b>is</b> .	[24, 26,29,30, 33]
Struvite	3500-2700 <b>bm</b> ,2345 <b>w</b> ,1675 <b>iw</b> ,1435 <b>im</b> ,1025 <b>is</b> ,760 <b>iw</b> ,571 <b>im</b>	[24, 26,29,30, 33]
Calcite.	1398 <b>is</b> , 1025 <b>im</b> , 870 <b>is</b> , 720 <b>im</b> , 521 <b>iw</b> , 503 <b>iw</b> .	[24, 26,29,30, 33]

s: strong, m:medium, w: weak, b: broad, v: very,i:intanse.

**Morpho-constitutional classification:**

We were able to classify the 100 stones into 5 categories after analyzing them using Fourier-transform infrared spectroscopy (FTIR), three of which were defined by the majority lithiasis component (whewellite, calcium phosphates, uric acid), a fourth for urea infection stones (PAM), and a fifth for mixed structure stones associating in equal proportions calcium oxalate and calcium phosphate. The epidemiology of urinary lithiasis in southwestern Algeria is described in this statistical analysis.

**Table 3:**Frequency of lithiasis compositions for urinary stones from southwestern Algeria.

Main component	Total		Number		Frequency (%)	
	Number	rFrequency(%)	Men	Women	Men	Women
Oxalate ofcalcium (WH)	64	64(%)	44	20	44(%)	20 (%)
Phosphates ofcalcium (CA)	5	5 (%)	4	1	4(%)	1 (%)
Struvite (ST)	6	6 (%)	1	5	1 (%)	5 (%)
Uric acidanhydride (AUA)	17	17 (%)	16	1	16 (%)	1 (%)
Uric acididihydrate (AUD)	5	5 (%)	4	1	4 (%)	1 (%)
Calcite (bicarbonate of calcium)	3	3 (%)	3	0	3 (%)	0 (%)

**Distribution of the major components of urinary stones:**

The majority component of a stone is important to understand because it reflects the urinary environment and, thus, the pathology or abnormalities responsible for the lithogenic process’s activity. They can be mono- or multi-component. Throughout this work, only the majority compound will be considered. Table 5 depicts the distribution of the majority component of the stones. The results show that calcium oxalate (type I) is the most common compound in the stones, accounting for 64% of the

total, followed by uric acid (22%) and carbapatite (5%).The presence of struvite is remarkable at 6%. The other components have low percentages (calcium carbonate is 3%).

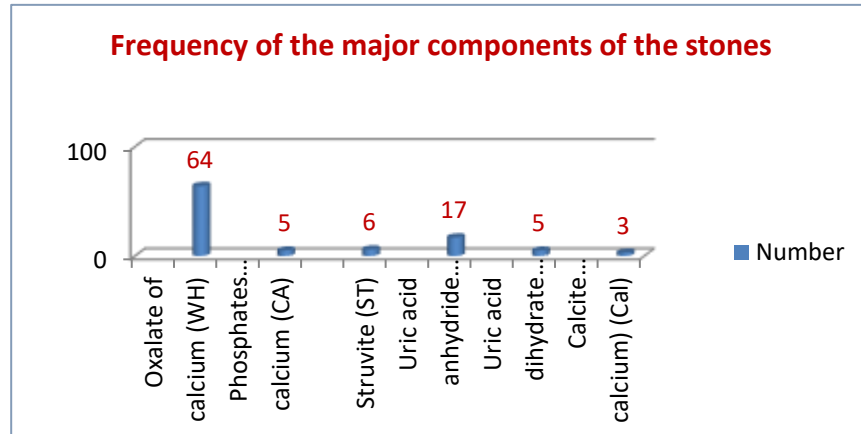
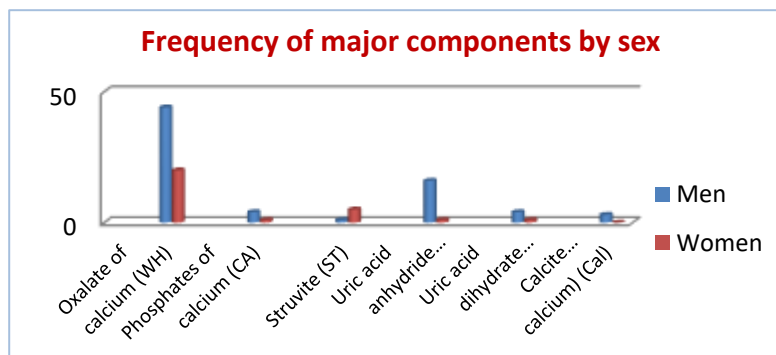


Figure 21: Distribution of the major components of the stones.

Table 4: Frequency of lithiasis compositions for urinary stones in southwest Algeria.

Main component	Total	Men	Women
Pure Whewellite	31	19	12
Pure weddellite	0	0	0
Pure Carbapatite	0	0	0
Uric acid anhydridepure	17	16	1
Pure uric acid dihydrate	5	4	1
Struvite	6	1	5
Pure Calcite	0	0	0
Whewellite+ weddellite	6	4	2
Whewellite + weddellite+ Carbapatite	3	3	0
Whewellite + Carbapatite	26	20	6
Carbapatite+ Whewellite	3	3	0
Calcite +Carbapatite	3	3	0

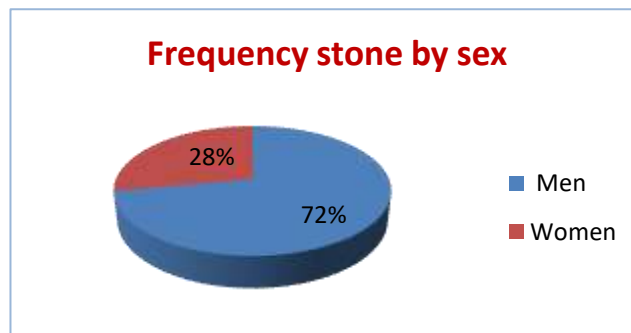


**Figure 22:** Distribution of the major components of the stones.

The results show that oxalo-calcic stones (64%) predominate, followed by uric acid (22%) and infection stones (struvite is the majority in 6% of the cases), with calcium phosphates accounting for only 5% of the cases (Table 5). Among the oxalic-calcium stones, whewellite is more common than weddellite. Table 6 depicts the distribution of lithiasis components, and the figure for the entire series of stones was analyzed using Fourier transform infrared spectrophotometry. According to this study, lithiasis disease affects more men than women, with an M/F ratio of 2.5.

**Sex distribution of lithiasis patients**

Men have long been known to be more prone to urinary tract lithiasis than women. Men predominated in our study with a frequency of 72% compared to only 28% in women (i.e., an M/F ratio of 2.5). These findings are similar to those reported by Daudon et al. in France in 1995 (70.1% of men versus 29.9% of women)<sup>[13]</sup>, but higher than those reported by Grases et al. in Spain in 1994 (56.4% of men versus 43.6% of women)<sup>[14]</sup>.



**Figure 23:** Distribution of urinary stones by sex.

**Age distribution of lithiasis patients:**

The risk of developing a specific type of stone varies with age. Human eating habits and metabolism change as we get older. However, the risk of developing certain pathologies that promote stone formation varies with age. The result is that the frequency of lithiasis components varies with age. Calcium-dependent lithiasis is much more common before age 30, whereas uric acid lithiasis is much more common after age 70<sup>[15]</sup>. In women, infection stones predominate, whereas uric acid stones begin to increase in men between the ages of 60 and 80. Table 08, depicts the anatomical distribution according to age groups, with lithiasis dominating in adults. This preponderance is greater in lithiasis patients aged 30 to 60 years and those aged 20 to 30, with 60% and 5%, respectively.

**Table 5:** Distribution of major components of the stones by age.

Age (years)	20-30	30-40	40-50	50-60	60-70	More than 70
Number	5	16	19	25	7	25

Frequency (%)	5%	16%	19%	25%	7%	25%
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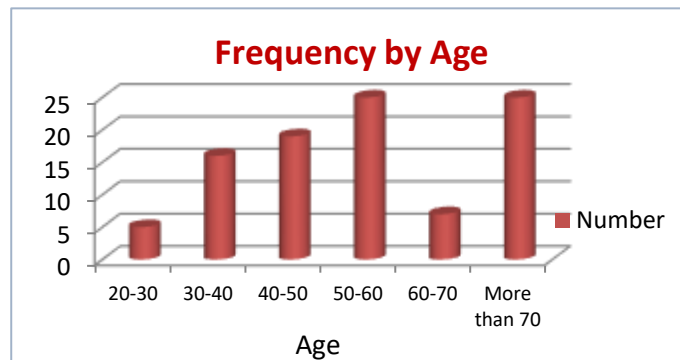


Figure 24: Distribution of the major components of the stones by age.

According to the results summarized in Figure 9, 60% of the lithiasis patients were aged 30 to 60. Only 5% of lithiasis patients were under the age of 30, 7% were between the ages of 60 and 70, and 25% were over the age of 70.

**Distribution by location:**

Figure 10 depicts the results of the stone distribution study based on sex and overall anatomical location. The majority of the stones (69% (68% in men and 31% in women) were found in the upper urinary tract, compared to 31% in the bladder (83% in men and 16% in women).

Table 6: Distribution of major components of stones by location.

Lithiasis of the upper urinary tract	69	Men	47
		Women	22
Bladder lithiasis	31	Men	26
		Women	5

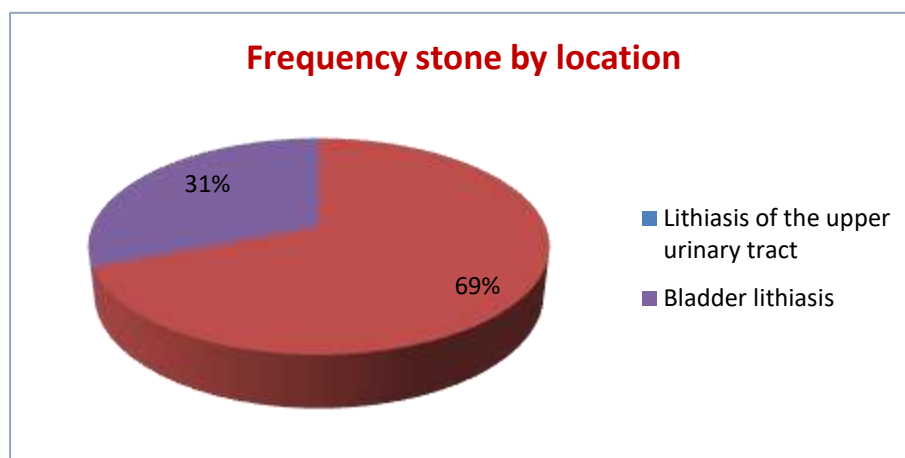


Figure 25: Distribution of the major components of the stones by location.

The distribution of stones by anatomical location and gender reveals that most stones are found in the left kidney, with a rate of 32.9% (28.6% in men and 45.5% in women) (Table 9). Right kidney stones account for 16.5% of all cases (19% in men and 9.1% in women). The left and right ureters have frequencies of 15.3 and 12.9%, respectively, with the left predominating in men and the right predominating in women. The remaining 18.8% of stones in the bladder were of the dominant masculine sex.

**Distribution by mode of stone disposal:**

The analysis of different stone removal methods reveals that surgery accounts for 93% of the cases, with 7% of patients removing their stones spontaneously. These findings do not reflect reality because most spontaneous cases do not seek medical attention.

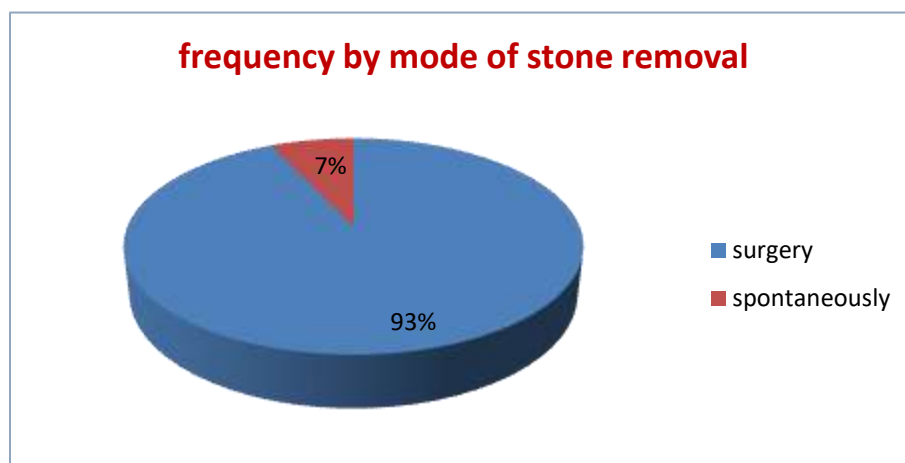


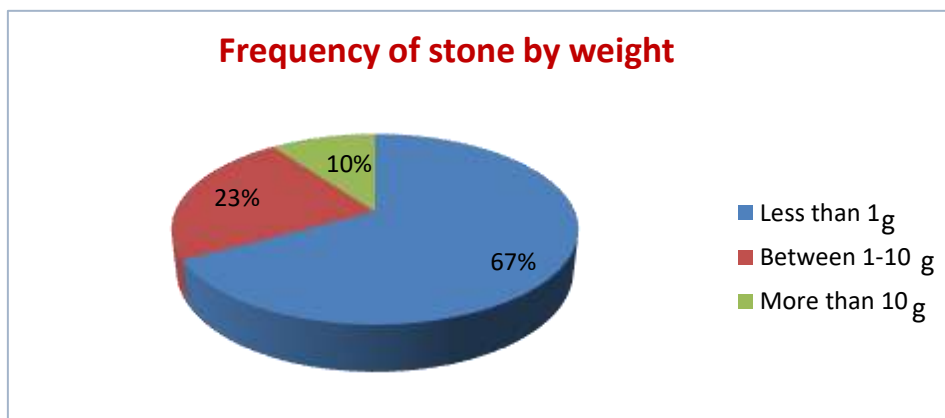
Figure 26: Distribution of majority components of stones by mode of stone removal.

**Stones' weight:**

Stones weighing less than 1g were the most frequent (67%), followed by stones weighing between 1-10g (23%), while stones weighing more than 10g were present in 10% of cases (Figure27).

Table 7: Distribution of the majority components of the stones according to the weight of the stones.

Weight	Less than 1g	Between1-10g	More than 10g	Total
Number	67	23	10	100

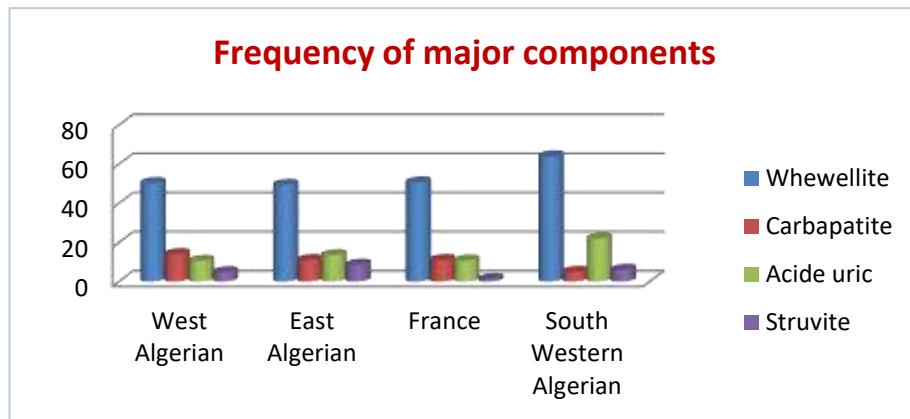


**Figure 27:** Distribution of the majority components of the stones by weight.

**Comparison with literature data (results in percentages observed in each series):**

**Table 8:** Frequency of lithiasis compositions for urinary calculi in southwestern Algeria, westernAlgeria, eastern Algeria and France<sup>[11, 13, 16]</sup>.

	WestAlgerian	EastAlgerian	France	South WesternAlgerian
<b>Whewellite</b>	<b>50,3 %</b>	<b>49,4%</b>	<b>50,7%</b>	<b>64%</b>
<b>Carbapatite</b>	<b>14%</b>	<b>11%</b>	<b>11%</b>	<b>5%</b>
<b>Uric acide</b>	<b>10.6%</b>	<b>13.5%</b>	<b>10.8%</b>	<b>22%</b>
<b>Struvite</b>	<b>4.8%</b>	<b>8.6%</b>	<b>1.3%</b>	<b>6%</b>



**Figure 28:** Frequency of lithiasis components for urinary stones.

The comparison of the results with the other studies reveals a significant difference, such as calcium oxalate being present in the majority of the stones in 64% of the cases compared to the other studies (50.3%, 49.4%, 50.7%) respectively (Algerian West and East and France). This finding can be explained by the amount and quality of water consumed daily and the climatic factor. On the other hand, calcium phosphates constituted the majority 5% of cases, i.e., lower than those reported in (West and East Algeria and France) <sup>[11, 13, 16]</sup>. The presence of uric acid in the stones is more common in our series than in the other studies (50.3%, 49.4%, and 50.7% in West and East Algeria and France, respectively). The patient’s overweight, age, and food quality may contribute to the development of uric lithiasis. Struvite has been found in both men and women in other studies, but the overall frequency of 6% in our series is comparable to that reported in other studies (4.8%, 8.6%, and 1.3%) in Western Algeria, Eastern Algeria, and France. The presence of struvite indicates the presence of an infectious lithogenic context associated with urea germs

**Ethnopharmacology survey:**

Based on the work done on the plants used for their inhibitory effect on calcium oxalate lithiasis and the bioactive molecules responsible for the inhibitory effect, we have chosen some plants according to their constituents and their therapeutic effect, which have not been studied for their effect on the inhibition of calcium oxalate lithiasis. We investigated the effect of plant ten extracts on the dissolution of calcium oxalate kidney stones (pure) in vitro. According to the preliminary results, four plants perform well:

3. Ajugareptans(L);2- Acacia radiana ;3-Cassiaaccutifolia (L);4-Anthyllisvulneraria.

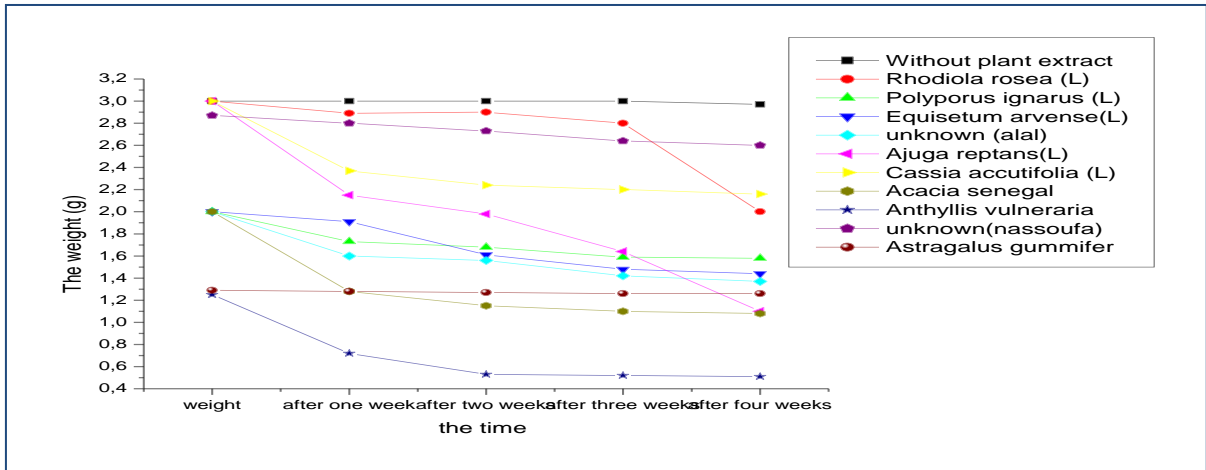


Figure 29: Mass loss of calcium oxalate stones.

**Evaluation of dissolution rates:**

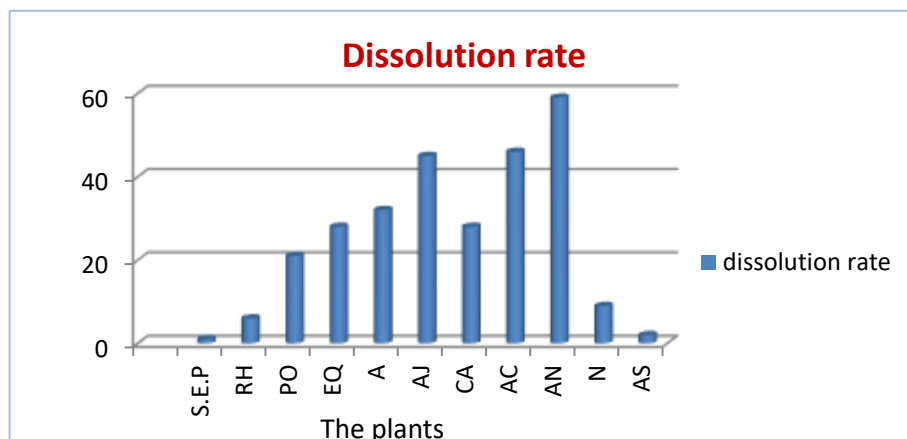
The formula calculated the percentage of dissolution:

$$A\% = (Initial\ W - Final\ W) \times 100 / Initial\ W$$

Where, A% is the dissolution rate, W initial and W final are, respectively, the stone weights before and after incubation in the plant extracts.

Table 9: dissolution rate.

the plants	S.E.P	RH	PO	EQ	A	AJ	CA	AC	AN	N	AS
Degradation%	0.03	0.2	0.43	0.57	0.64	1.37	0.85	0.92	0.74	0.27	0.03
dissolution rate%	1	6.66	21.5	28.5	32	45.66	28.33	46	59.2	9.40	2.32



**Figure 30:** Dissolution rate of calcium oxalate stones.**Discussion of results:**

This study included 567 lithiasis patients, 67% of whom were men and 33% of whom were women. For a long time, men have been known to be more vulnerable to urinary tract lithiasis than women [12,13]. However, based on our findings, we discovered that the prevalence of urinary tract infection is interchangeable between the sexes throughout our study. We also discovered a male predominance with a frequency of 66.84% versus 33.16% in women (an M/F ratio of 1.95). Our findings showed that 56.6% of lithiasis patients were between 30 and 50. The most common period of lithiasis was in 2011, and the frequency was higher for both sexes than in previous years. The upper urinary tract had the highest percentage of stones (66% vs. 34% in the lower tract). Calcium oxalate is the main component of stones in southwestern Algeria, as in other countries, accounting for 64% of all stones. Phosphates predominate in 5% of cases, Uric acid in 22% of cases, Struvite in 6%, and Calcite in 3% of cases.

**Gender influence:**

Calcium oxalate was the most frequently encountered constituent in our study, with a frequency of 64% (65% in men and 34% in women), with Whewellite dominating. Carbapatite was the most common constituent in 5% of the cases (70% in women and 30% in men), followed by Struvite in 6%, with a higher frequency in women. Anhydrous uric acid accounted for 22% of the cases, with men being more likely to be affected.

**Age influence:**

Due to the small number of subjects, the influence of age on stone composition is not discernible, particularly for the first age group. Calcium oxalate was found in high concentrations in all age groups; especially in lithiasis patients aged 35 to 60 (70%). In subjects over 70, anhydrous uric acid was the second most prevalent component. Struvite was the most common component in subjects aged 20 to 40 and 40 to 60, with significant frequencies of 20% and 80%, respectively.

A magnifying glass examination revealed that 64% of the stones are type I (calcium oxalate monohydrate), 22% are type III (uric acid), and 6% are type IV (struvite). Type II (calcium oxalate dihydrate) stones account for 5% of all stones, while type IV (phosphate compound) stones account for 5% (Table 5). The epidemiological study of urinary lithiasis in patients from the West Algerian region of Becharwillaya reveals a slight male predominance, as observed in other countries worldwide. The M/F ratio of 2.5 is higher than in some European countries such as Spain (1.26)<sup>[13,14]</sup>, but similar to that reported in a series in France (M/F=2.27)<sup>[13]</sup> and 2.68 in Japan<sup>[21]</sup>. The analysis of a large series of stones from various countries around the world [13,14, 21,22] reveals a clear preponderance of oxalocalciclithiasis, which was identified in more than 80% of the stones and represented the majority constituent of about 70% of the stones [13,14, 20-22].

It can also be noted that calcium oxalate was the most common component in 64% of the stones. The distinction of calcium oxalate crystalline phases highlights the differences between our results and those observed in France<sup>[13]</sup>. In our series, whewellite predominated in 64% of the cases compared to 42.8% of the French stones, and Weddellite was almost non-existent in our stones compared to 23.2% of the French stones. Whewellite and Weddellite were the main compounds in 50.3% and 16.7% of the stones in the Algerian series published by Djelloul, respectively<sup>[17]</sup>, which differs from our study.

After eight weeks, the average mass loss of calcium oxalate stones (pure Whewellite) was 70 30 mg across all experiments. Figure 14 depicts the changes in the mass of Whewellite stones during incubation with each extract or the control solution. The dissolution kinetics of each plant extract appear to be different. The mass of the stones varied greatly during the first two weeks. The dissolution rate was average between two and four weeks, and it remained low between four and six weeks, particularly for (*Ajugareptans(L)*) and (*Acacia radiana*), (*Cassia accutifolia*), and (*Anthyllisvulneraria*).

After eight weeks, the results were confirmed, with these four plant extracts having a more pronounced effect on stone dissolution than the others, as evidenced by a significant mass loss compared to the other extracts, particularly the NaCl solution. The loss of mass was 1.37g at the end of the experiment (eight weeks) for the extract of *Ajugareptans(L)*, 0.92 for *Acacia radiana*, 0.85 g for *Cassia accutifolia*, and 0.74g for the extract of *Anthyllisvulneraria*, while it was 0.57g for *Equistumarvenus* and 0.03 g for the NaCl control solution. The results of the analysis of crystallization filtrates in the absence and presence of aqueous plant extracts confirm the results of the effect of plant extracts on calcium oxalate crystallization. The results obtained from the crystallization filtrate in the absence are compared to the results obtained from the crystallization filtrate in the presence of aqueous plant extracts:

The aqueous extract of *MarrubiumvulgareL.* and *Ajugaiva(L.)* Schreb did not give any inhibitory effect on the oxalo-calcic crystallization; the aqueous extract of *Equisetum arvense (L)* gave an inhibiting effect on the concertation of calcium oxalate crystals obtained in the solution during the oxalo-calcic crystallization; aqueous extract of *Zizyphus lotus Desf.* And *MenthasuaveolensL* and *Anthyllisvulneraria* gave an inhibitory effect on form of calcium oxalate crystals (from Whewellite form to Weddellitedihydrate form); aqueous extract *Cassia accutifolia (L)* gave a total inhibitory effect on the concentration of Oxalo-calcium crystallization and the form of calcium oxalate crystals (from Whewellite form to Weddellitedihydrate form). Only a change in environmental factors can explain the marked increase in the frequency of lithiasis over the last half-century, as well as changes in eating habits and the standard of living with population health levels, not to mention the problem of environmental pollution. Environmental pollution, which causes metabolic disorders and intoxication of metabolic organs, is the most common factor in our region, followed by blood acidosis, which promotes chronic diseases (diabetes, hypertension, gout, cardiovascular disease, and lithiasis disease). Although lithogenesis not always well understood, several hypotheses are being considered:

1. There is a lack of crystallization inhibitors. 2. There are crystallization indicators present. 3. The presence of an organic matrix promotes crystallization.

According to our findings, lithogenesis caused by heavy metal intoxication (food, water, air) causes metabolic disorder (organ destruction), and hormonal secretion disruption promotes chronic diseases. The stone analysis provides information that can be used to better understand the mechanisms involved in their formation. As a result, it should be the first step in the etiological investigation. Identifying the causes of lithiasis enables effective therapeutic or dietary measures to be implemented to prevent, reduce, or stop the recurrence of stones. The composition of the preliminary stones from 100 cases of urinary lithiasis brought to the Service of Urology of the Hospital Ahmed Torabi and the private clinic of Wilaya of Béchar in Algeria's Southwestern were collected and analyzed using Fourier Transform Infrared Spectrophotometry (FTIR) at the Laboratory of Infrared and Raman Spectroscopy, University Tahri Mohamed Bechar Algeria.

Renal lithiasis predominated, accounting for 69% of all stones, followed by bladder lithiasis (31%), with the right side predominating in both sexes. The stones' FTIR analysis revealed a high frequency of calcium oxalate monohydrate (64%), anhydrous uric acid (22%), struvite (6%), calcium phosphates (5%), and calcite (3%). Whewellite (Wh) + carbapatite (CA) mixtures were the most frequently encountered, with a frequency (of 52.17%).

In vitro investigation of the inhibitory effect of ten aqueous extracts on the dissolution of calcium oxalate (Whewellite) stones. The results obtained after eight weeks show that the aqueous extract of skink plant extracts has a more pronounced effect on stone dissolution than other plants, with dissolution rates for the extract of *Anthyllisvulneraria* (59.2%), *Acacia radiana* (46%) and *Cassia acutifolia* (L) (45.66%), on the other hand, being average for *Equistumarvenus* (28.5%) and *Ajugareptans* (L) (28.33%) Our findings also show that *Cassia acutifolia* (L) extract has a total inhibitory effect on calcium oxalate crystallization, as well as an inhibitory effect on the form of calcium oxalate crystals from Whewellite to Weddellite, the least frequent and thermodynamically less stable form, for *Menthasuaveolens* L, *Anthyllisvulneraria*, and *Zizyphus lotus* Desf. Furthermore, the aqueous extracts of *Ajugareptans* (L) and *Equistumarvenus* inhibited the concentration of calcium oxalate crystallization, but the extract *Marrubiumvulgare* L had no inhibitory effect on calcium oxalate crystallization.

### **Conclusion:**

Environmental factors, climatic conditions, and dietary habits exert the greatest collective impact on lithiasis disease<sup>[35-37]</sup>. Our findings show that combining FTIR spectroscopy and optical microscopy is the best method for analyzing urinary stones. Our findings support the family's (RAMNACEAE) efficacy in dissolving calcium oxalate-type stones and inhibiting calcium oxalate crystallization. The results of the experiments show that while some plants cannot break down urinary stones, they may be able to prevent them. The in vitro study on the effect of *Cassia acutifolia* (L) aqueous extract on oxalate crystallization demonstrates the effectiveness of this plant in preventing oxalic-calcic lithiasis.

This property is beneficial in preventing oxalic lithiasis because it reduces crystal formation, which is the first stage of the lithiasis process.

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