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Evaluation of the potential phoenicicol biomass sub-product in the Guerrara oasis

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***Abstract*— The objective of this paper is to study the potential phoenicicol biomass sub-product evaluation in the Guerrara Oasis ecosystem. The goal to carry out this study is to determine different possibilities of energy recovery resource.**

The obtained experimental results provide an identification of main phenocicol sub-products, which are available and not fully recovered; named: *kernaf, addaf, saqqas, khallab, arjoun, lif* and *djerid,* as well as a quantitative assessment taking into consideration the biodiversity.

The concluded results averred an annual biomass potential quantity, estimated at about 11 366 tons, generated by 218 467 date palm trees in Guerrara oasis.

The recorded results following this study were encouraged for an eventual energetic valorization, but it must be improved through biomass energy evaluation and extensive structural element analysis, as (C, 0, H, N, S).

***Keywords*— evaluation, phoenicicol biomass sub-product, Guerrara Oasis.**

I. INTRODUCTION

Energy always constitutes a vital and planetary challenge for the development of the humanity; nevertheless it is an undeniable source of pollution, which incites the Scientifics and the decision makers to find alternatives clean and renewable solutions [1].

The biomass energy valorization presents an important alternative to fossil fuel sources, due to its many advantages; as: the availability, the storage process control and the carbon balance [1, 2].

In the aim to treat suitably this valorization, the biomass assessment seems to be necessary. This conclusion is due to the biomass data inexistence in the case studied, as well as the reliability of few accessible data [3].

The current study has to evaluate the biomass phoenicicol potential, generated by the different farming operations. The energy valorization of this resource could answer partially to the energy needs in the oasis ecosystem, since the date palm trees (*phoenix dactilifera L.*) constitutes the main biomass in this space [4].

The project of the evaluation of biomass phoenicicol potential sub-product relates to whole Mzab area, however, the choice of the Guerrara oasis area like model zone for the starting of this study is based on several reasons. The two principals are: the organization of the agricultural activity in this space and the cultural calendar of the biomass phoenicicol which favourites the sampling operations.

II. MATERIALS AND METHODS

A. Origin and sampling period

The samples were taken on four agricultural areas of the Guerrara oasis (figure 1). The sampling had carred on the ten most frequent varieties in the Guerrara oasis as indicated in table 1 [10].

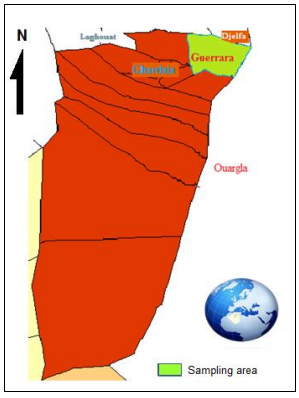

Fig.1 : Sampling area

Sampling was conducted during April, which is the period of date palm pollination. This operation coincides with the oasis cleaning period in the Guerrara (cf.table.1). This is one among the reasons of choosing the mentioned area.

Table 1: Sampling calendar depending on date palm cultivars in the Guerrara oasis

Period / Varieties	1st week April	2nd week April	3rd week April	4th week April
DELET NOUR				
GHARS				
TAFIZIWIN				
AZERZA				
BENT QBALA				
KSEBA				
TANESLIT				
DEGLA BEIDA				
TIMJUHART				
ADDALA				

B. Sampling procedure :

The sampled biomass constitutes the principal sub-product collected following the date palm cleaning operation period (cf. table and fig. 2).

Table 2:

Scientific and local designation of principal studied phoenicicol sub-products

Local designation	Scientific French designation *
Lif	Fibrilium, Lif
Djerid	Palme
Kernaf	Petiole, Kornaf
Arjoun	Hampe florale
Khallab	Envelope de la spathe
Addaf	Partie épineuse de la palme
Saqqas	Régime

Source [5] : ألفاظ النخلة بالعربية و الميزابية (سليمان بن سعيد بكاي)

Arjoun

Saqqas

Lif

Djerid (addaf, kernaf)

Fig.2 : Photos of the main studied phoeniciciol sub-products (GHARS variety case)
Source : Bousdira K-Guerrara 2012

For easy designation, we have used the local arab vocabulary.

In terms of the sampling methodology, we have tried, as much as possible, to respect the Spanish standard CEN / TS 14778-1 for solid biofuels [6]. Nevertheless, considering the time and the limited resources, the described method in the standard had been adapted to the actual field conditions. Two criterias were used for the palm trees selection sampling target, based on: feet well maintained and in full production (fruitful trees).

Stored samples at ambient temperature were quickly transferred to URAER biomass laboratory for preparation [7] and analysis.

C. Data Collection:

Collecting data for each sub-product type was conducted through survey farmers during the sampling operation. The survey sheet used during field work is shown in Figure 3. In addition, measurements were executed on each sample (weight, height and number).

Fig.3 : Survey sheet [8]

III. Results and Discussion

A. Number of different sub-products generated by ten date palm cultivars in the Guerrara Oasis:

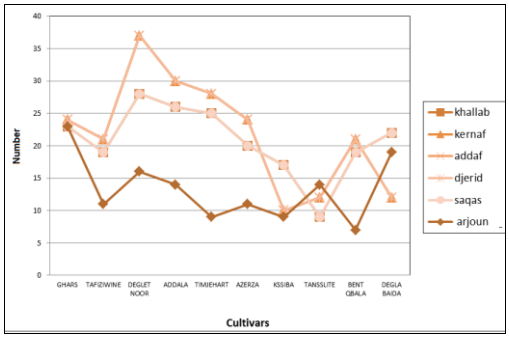

Fig. 4: Different sub-products Number generated by ten date palm cultivars in the Guerrara Oasis

The graph 4 represents the number of different sub-products generated by ten date palm cultivars in the Guerrara Oasis and describes the followings:

- The palm sub-product (which includes: *djerid*, *kernaf* and *addaf* parts) number is estimated an average value of about 22 (TAFIZIWINE), varies between 10 (KSEBA) and 37 (DEGLET NOUR).
- The *saqas* (*arjoun* basal part) and *khalab* (envelope of the scape) sub-product number are estimated an average value of about 21 and varies between 9 (TANESLIT) and 28 (DEGLET NOUR).
- The *arjoun* sub-product number is estimated an average value of about 13, varies between 7 (BENT QBAL) and 23 (GHARS). This variation is also explained by the date palm maintenance (irrigation and soil fertilization) and the age of the palm which is practically the same for ten varieties.

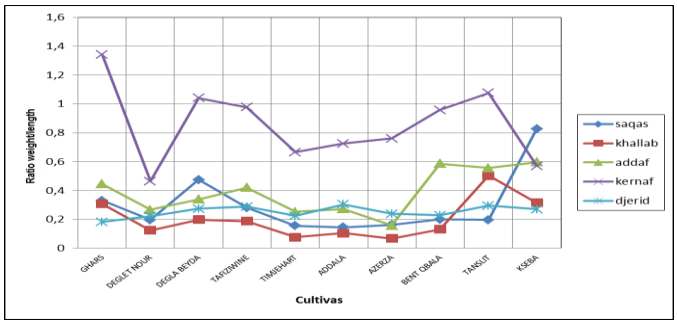

Fig. 5: Relationship between weight and length of the ten date palm cultivars sub-products

The *arjoun* number is slightly less important than the *saqas* and *khalab*. This is explained by the chiseling operation for removing some *arjoun* number to allow a better fruit quality.
The palm (*djerid*, *addaf* and *kernaf*) number is more important than the other palm parts mentioned above. This is due to several reasons:
• The fine texture of the palm dominant part as shown in the relationship between weight and length of the studied parts (0.18 kg / m), is exposed under the weather conditions, especially the temperature elevation witch causes rapid drying of palms in comparison with other parts (ratio weight / length is highest cf. Figure 5).
• The optimization of evapotranspiration by palm drying.

B. Weight unit of the various sub-products generated by ten date palm cultivars in the Guerrara Oasis:

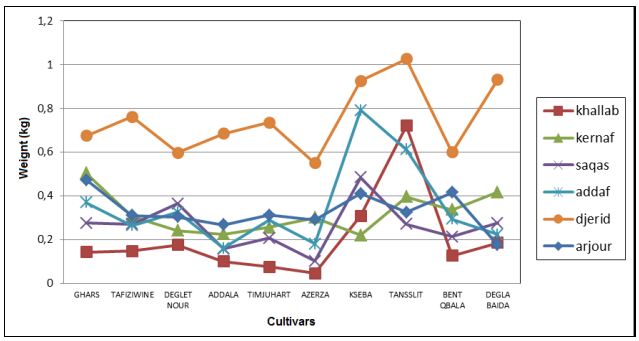

Fig 6: Weight unit of various sub-product generated by ten date palm cultivars in the Guerrara Oasis

Figure 6 shows the weight unit of the main ten palm date cultivars sub-products:

• The *djerid* sub-product weight unit is estimated in average of about 0.748 kg (TIMJUHART) and varies between 0.55 kg (AZERZA) to 1.027 kg (TANESLIT).

• The *addaf* sub-product weight unit is estimated in average of about 0.351 kg (GHARS) and varies between 0.16 kg (ADDALA) to 0.791 kg (KSEBA).

• The *khallab* sub-product weight unit is estimated in average of about 0.202 kg (DEGLA BEYDA) and varies between 0.045 kg (AZERZA) and 0.712 kg (TANESLIT).

• For the remain sub-product : *arjoun*, *saqas* and *kernaf*, we remarked a small variation in the weight unit : witch is estimated in average of about 0.328 kg, 0.262 kg and 0.319 kg respectively.

Figure 6 also shows that the *djerid* sub-product has the largest weight in comparison with other sub-product. Contrary to *khallab* which is the lightest phoenicicol sub-product, except the TANESLIT variety within weight of 0.721 kg. We also note that the *addaf* KSEBA weight unit is relatively important (0.791 kg). Both *saqas* and *khallab* of AZERZA variety are the lightest byproducts with a weight of 0.045 kg and 0,101 kg, respectively.

C. Sub-products total weight of ten date palm cultivars in the Guerrara Oasis

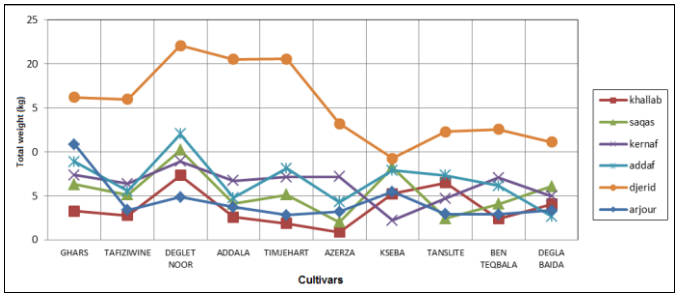

Fig. 7: Main sub-product total weight of ten date palm cultivars in the Guerrara Oasis

The total weight of each sub-product is calculated as follows:

$$total\_weigth_{sub\_product} = weigth\_unit_{sub\_product} \times number_{sub\_product}$$

Figure 7 shows the main sub-product total weight of ten date palm cultivars in the Guerrara Oasis:

• The *djerid* sub-product total weight is estimated an average value of about 15.393 kg (TAFIZIWINE) and varies between 9.26 kg (KSEBA) to 22.089 kg (DEGLET NOUR).
• The *addaf* sub-product total weight is estimated an average value of about 6.78 kg (QBALA BENT) and varies between 2.68 kg (DEGLA BEYDA) to 12.02 kg (DEGLET NOUR).
• The *saqqas* sub-product total weight is estimated an average value of about 5.37 kg (TAFIZIWINE) and varies between 2.02 kg (AZERZA) to 10.22 kg (DEGLET NOUR).
• The *kernaf* sub-product total weight is estimated an average value of about 6.28 kg (case of TAFIZIWINE variety) and varies between 2.20 kg (AZERZA) to 8.91 kg (DEGLET NOUR).
• The *khallab* sub-product total weight is estimated an average value of about 3.69 kg (GHARS) and varies between 0.90 kg (AZERZA) to 7.33 kg (DEGLET NOUR).
• The *arjoun* sub-product total weight is estimated an average value of about 4.35 kg (DEGLET NOUR) and varies between 2.81 kg (TIMJUHART) to 10.88 kg (GHARS).

Analysis of graphs 6 and 7 also shows that the dominant sub-product in volume and weight is *djerid*. This is explained by the fact that this part of the date palm is the canopy of the tree witch plays a crucial role in its development (photosynthesis) and its protection.

We also noted that the DEGLET NOUR variety generates the largest quantity of sub-product, due to the sub-product large number obtained after the cleaning operation.

The variety AZERZA has an opposite characteristics; this is explained by the lightness of the generated sub-products.

The GHARS *arjoun* part differs significantly by its heavy weight and the important generated sub-product number.

D. Total cumulated weight of the main sub-products generated by ten date palm cultivars in the Guerrara oasis

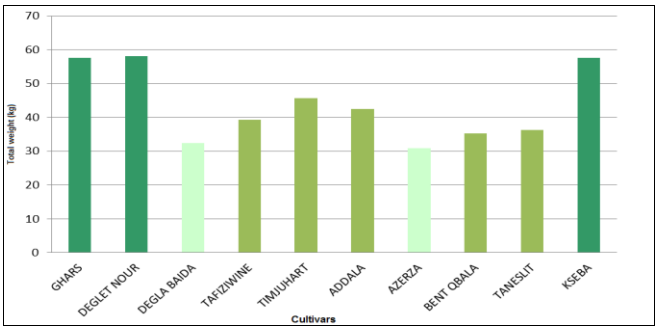

Fig. 8: Total cumulated weight of the main sub-products generated by ten date palm cultivars in the Guerrara oasis

Graph 8 shows the total cumulated weight of the main sub-products generated by ten date palm cultivars in the Guerrara oasis. This parameter is calculated as follows:

$$cumulated\_weight_{sub\_product} = \sum weight_{different\_sub\_product}$$

This parameter varies between 30.83 kg (AZERZA variety case) and 58.11 kg (DEGLET NOUR variety case), and is estimated in average of about 43.55 kg (ADDALA)

The figure 8 also shows that DEGLET NOUR, GHARS and KSEBA varieties generate the largest quantity of sub-product; about 58 kg per variety. This characteristic gives to these varieties a major importance in the field of phoenicicol sub-product valorization in the oasis ecosystem.
This characteristic is opposite in case of AZERZA and DEGLA BAIDA varieties (31.5 kg an average value) which places them in last place for a possible recovery.

E. Evaluation of the potential phoenicicol biomass in the Guerrara Oasis

TABLE 3:

ÉVALUATION OF THE POTENTIAL PHOENICICOL BIOMASS IN THE GUERRARA OASIS

Cultivars	Total_weight_sub_product (per date palm tree in kg)	Date_palm _number	Total_cumulated_ weight_sub_product (ton)
GHARS	57,65	48191	2778,018
DEGLET NOUR	58,11	89383	5194,493
DAGLA BAIDA	32,36	4111	133,040
TAFIZIWINE	39,30	28359	1114,594
TIMJEHART	45,70	17173	784,823
COMMUNES VARIETIES	43,55	31250	1360,937
TOTAL	-	218467	11365,906

Considering the biodiversity component in the Guerrara oasis, and based on the total weight of the main phoencicol sub-products, we have calculated the amount of biomass generated by the major date palm cultivars in this space (see Table 3). These quantities are important and valuable, they are neighborhood of 11 366 tons in total phoenicicol wood sub-product, and could be a very interesting potential energy in the oasis ecosystem [9].

IV. Conclusions

We are reached through this study of the biomass potential evaluation in the Guerrara oasis, the following conclusions:

• Identification of biomass phoenicicol, represented by the date palm sub-products, which constitutes the dominant cultivation in the studied ecosystem.

• Identification of the main sub-product phoenicicol available and not fully vaporizable at the studied oasis. The study involved seven sub-products (*kernaf*, *addaf*, *saqqas*, *khalab*, *arjoun*, *lif* and *djerid*), of the ten most important Guerrara oasis cultivars. The parameter biodiversity has been considered due to its importance in the ecosystem.

• Phoenicicol biomass quantitative assessment by determining the number and the weight of each sub-product generated by date palm tree, and an overall assessment by considering the biodiversity component.

A global summary of the evaluation shows that the amount of generated phoenicicol sub-product is very interesting especially for the palm part (*djerid*, *addaf* and *kernaf*) and for the dominant varieties DEGLET NOUR, GHARS and KSEBA; witch give them a particularities to all valorization principally on the bioenergy.

Finally, this work serves as a starting point for the energy valorization from biomass in the oasis ecosystem and must be supplemented by a detailed study of the main sub-products to approach adequately this evaluation.

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