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RESEARCH ARTICLE

CLARIFICATION OF POND WATER BY MORINGA OLEIFERA ALMOND POWDER FOR DRIP IRRIGATION

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ABSTRACT

In arid and semi-arid areas, where water is a imitating factor, the agriculturals use other system of irrigation especially the drip to drip one for the agricultural production. The ground water particularly the pool waters employed are generally trouble and limit the working device of drip to drip irrigation due to clogging of the drippers. The aim of this study is to test the kernel powder of Oleifera Moringa for the pool water clarification in order to improve the durability of drip to drip system of irrigation. The pool waters of Kongou Gorou Zarmadandey is located in North-East at 7km of Niamey in Niger has been taken away for the treatment. The latter found on coagulation-flocculation with a recipient - test consists in applying the kernel powder of Oleifera Moringa respectively dried at three temperatures (25, 40 and 50° C) and applied by three doses (50, 100 and 150 mg, l-1).). The parameter sized up is essentially the turbidity of water. The results has showed that the application of kernel powder of Oleifera Moringa clarified significantly the pool water especially from 30 minutes of decantation. In fact, the initial turbidity of the unrefined water (638 NTU) lowered significantly by 74, 99 and 99% respectively with the dose of 50, 100 and 150 mg / l of oleifera M. after 24 hours of decantation. The diminution of turbidity by oleifera M. is significantly higher with the doses of 100 and 150 mg / l than with the dose of 50 ml / l. The dose of 100 mg / l oleifera M. seems to be the optimal dose for the clarification of Kongou Gorou Zarmagandey pool waters. However, an additional works can be consider for studying the impact of oleifera M. kernel powder on the chemical and bacteriological quality of pool waters.

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INTRODUCTION

Without any doubt water is the most liquid used in the world. It is an universal commodity in which every live being inthe earth depend on it. It represents a key factor of developing, the productivity expansion and the productivity pegging in farming ,also the integration of agricultural production systems. Its management requires conciliate economics, socials objectives and environmentals complex (Michiels *et al*., 2009). Access to water is a major constraint affecting agricultural productivity and poverty in sub-Saharan Africa (FAO, 2008). Although the country is three -quarters is the desert, it provides in fact an important unexploited supply in underground water and ground (river, polls, tablecloth not deep, etc.) usable for agricultural purposes (Beck and Girardet: 2003). Thus, the superficial renewable resources in water in Niger is valued at 32, 5billion m3 per year; but only about 1% of these resources are used (FAO, 2005a). According to the General Census of Agriculture and Livestock (RGAC, 2012), the ground waters used for the irrigation are very under-exploited (less than 1% for the Niger River). The exploitation in maximum and optimal manner of these water potentials in which is available in the country will allow to solve the problem of insufficient and irregularityof rain (Joanne, 2007). Filali (2003) has showed that the water deficiency for the plants is redressed when one apply the supplemental irrigationand this allow an improvement in agricultural productivity. Gravitator irrigation, most developed in Niger, represents about 95% of the of large size irrigated perimeters in Niger, therefore water losses remain significant. . It is therefore necessary to reduce these losses, either by the rational management of water usage, or by the usage of propitiousirrigation techniques water-saving irrigation techniques such as drip to drip irrigation (Hasna, 2011). Indeed, the drip to drip irrigation is more and more developed to save irrigation water for agricultural production. . Hassan (2005) has showed that, this drip to drip irrigation technique has allowed to save 50 to 70% of water compared to gravity irrigation and 30% compared to sprinkler irrigation on vegetable crops. . Drip to drip irrigation has also increased the productivity by 20 to 40% orderand improved the quality of vegetable production (Elatir, 2005). However, the quality of the irrigation water has an influence on the durability of the drip to drip irrigation system because the water loaded in suspension blocks the drippers and limits the normal working of the device (El Amri, 2012).Chemical water treatment is frequently used for irrigation waters. The most widely used flocculants in the world today is aluminum sulphate taking account with its availability and its cost compared with other chemicals (Rakotoniriana *et al*., 2015). However, the latter is toxic and generates an accumulation of residuum. The usage of non-toxic biological water treatment processes is a constant alternative (Ngbolua *et al*., 2016). Indeed, Moringa oleifera seeds proved an effective solution for the treatment of irrigation water (Arnoldson *et al*., 2007), because its improve the physicochemical quality of water (Kaboré *et al*, 2015). The use of this biological process is ecological, respectful of the environment, inexpensive and accessible to the rural world (Ngbolua *et al*., 2016). The aim of this study is to test Moringa oleifera kernel powder for the clarification of pool water used for drip to drip irrigation. It is particularly important to determine the optimal dose of M. oleifera kernel powder for the clarification of pool waters. I. Materials and Methods

MATERIALS AND METHODS

Study site

The site study is the Kongou Gorou Zarmadandey pool (KGZ) located at 7 km north-East of Niamey in Niger (Figure N ° 1). The pool is divided into two parts: the first part is setting next to the village of KGZ qualify pool _KGZ limited by the banks A and B (Figure1) and the second part is the nearest to the village of Kongou Gorou (KGO) limited by the banks C and D (Figure 1) qualify pool_KGO. The two portions of the polls totalizes on the size of 9,596 ha (96.0 km²).

Plant material: The plant material used is Moringa oleifera and more precisely the kernel powder of the seeds. The seeds used in the present study come from the PKM1 variety of M. oleifera obtained by a selection of pure lines (INRAN, 2016). The choice of this variety is justified by its availability in the Sahelian zone, particularly in Niger, its easy accessibility and its relatively high productivity. It is also bit sensitive to parasites and its accommodate to different types of soil (Rajangarn *et al*., 2001).

Methods

***Preparation of the kernel powder*:** The powder that helped to the studies is obtained by the dry pod first manual hulling of M. oleifera. Then, the white kernel contained in these pods are dried for 30 days under three (3) temperatures: 25 ° C considered as the laboratory ambient temperature, 40 and 50 ° C in bake. After this drying operation, these kernels were crushed in a mortal by porcelaining and then sift with square loop of 0.5 mm.

Sampling of pool water: The sampling method adapted is one of the French Normalization Agency AFNOR (NF-T 1997). The taking away has been done at the Kongou Gorou Zarmadandey pool with 5 cans of 5l each and a 1l of bottle plastic. These containers were washed and rinsed with distilled water and closed. Once at the pool level, these cans and bottles were rinsed three times with the water of pool. The bottle is dipped and filled to a depth of 0.5 to 1 m every 10 m up to 50 m from the bank. At each point, 1 l of water is taken away and poured into each of 5 cans. Thus, at the last station, the 5 cans are filled, well closed and kept in the laboratory in a refrigerator at about 4 ° C.

Treatment processes and measurement of turbidity: In order to know the optimal dose of the coagulant, the test jar method was used. It has the advantage of evaluating whether the coagulant in study is suitable or not for dealing of beast water at a given dose and for estimating the abatement of turbidity. In fact, when the dose of coagulant into the water treated is optimal, the turbidity will be minimal (Boggio *et al*., 2009, Williams, 1984). In the laboratory, water samples have been treated with increasing doses of 50, 100 and 150 mg l-1 powder. The jar-test was performed in three repetitions R1, R2 and R3. In spades of 1000 ml of pool water, the different doses are introduced. These spades are introduced under a flocculator in electric command of six items in order to perform six successive stirrings to ensure good flocculation. The first stirring, energetic and short-time, consists to performs 160 rounds per 2 minutes to disperse the products in the entire volume of water. The second stirring is relatively slow is perform at a speed of 60 rounds per 20 minutes to favor flocculation in hanging particles. Finally, the mixture is leave to decant itself during 30 minutes before to proceed to the first measures. The turbidity measures of beastwater and after the time of decantation of the samples has been done by using a Nephelometric turbid meter

Statistical analyzes: The analysis of variance has been realized on base the data collected with Gen Stat software (version 12.1) and XLSTAT (version 2014) to compare the different treatments (the different doses and the different drying methods of M. oleifera kernel powder) on the turbidity of water. The means has been compared in pairs by the Fisher test at the 5% level.

RESULTS

Evolution of the turbidity of the water according to the dose of M. oleifera powder

The initial beast of pool water has a very high turbidity (638 NTU). After treatment with M. oleifera powder, water turbidity decreases with the decantation time for all M. oleifera doses and for all drying temperatures (Figures 2, 3 and 4). The diminution of turbidity water is maximum after 30 minutes of decantation time before stabilizing itself from 60 minutes of decantation for all doses and whatever the drying temperature of Oleifera M. seeds. The diminution of the initial turbidity is meaningful from 30 minutes for whole the oleifera M. doses and for whole the drying temperature. The turbidity lowering of water is higher with the doses of 100 and 150 mg/l than with the dose of 50 mg/l especially from 30 minutes of decantation of whole the drying temperature. Thus, after 24 hours of decantation, the turbidity of treated water is significantly higher with the 50 mg/l than with the dose of 100 and 150 mg/l for all the drying temperatures. However, there is any significant difference between the 100 and 150 mg/l doses and on the turbidity of treated water for drying temperatures. With the dried kernel power of M. oleifera at 25 ° C, the turbidity of the water passing from 638 to 150.3, 2.6 and 3.5 NTU which brings the diminution of 76.4, 99.6 and 99.4% respectively for the concentrations of 50, 100 and 150 mg / l after 24 h of decantation (Figure 2B). As for the treatment with kernel powder of M. oleifera dried at 40 ° C concerned, the turbidity of the water is reduced at 65.9, 99.2 and 99.3% respectively for the concentrations of 50, 100 and 150 mg / l after 24 hours decantation (Figure 3B). With the dried kernel power of M. oleifera at 50 ° C, the turbidity of the water increases from 638 to 132.7, 2.4 and 3.1 NTU, which brings the diminution of 79.2, 99.6 and 99.5% respectively for the concentrations of 50, 100 and 150 mg / l after 24 hours of decantation (Figure 4B).

Evolution of the turbidity of the water in function to the drying temperature of M. oliefera

The effectiveness of M. oleifera powder clarify pool water varies in function of the drying temperature of the kernel used. This variability is specially observed with the application of the 50 mg / l dose of M. oleifera (Figure 5).

In considering FIG. 5A, the turbidities obtained with the powders dried at 25 ° and 50 ° C. are statistically homogeneous but different from which obtained with the kernel dried at 40 ° C., especially from 30 minutes of decantation. The diminution of the turbidity in water is at 76.4, 65.9 and 79.2% for the 50 mg / l dose of M. oliefera dried at 25, 40 and 50 ° C, respectively. For doses of 100 and 150 mg / l, Moringa kernel powders dried at three temperatures, the turbidities are statistically equivalent (Figure 5B and 5C). Figure 6 illustrates the turbidities obtained at the dose of 100 mg / l of the kernel at the three temperatures. The turbidities after 72 hours of decantation, following the addition of 100 mg / l of the dried kernel powder to the different ones are statistically homogeneous, the initial turbidity's water (638 NTU) became more inferior than 1 NTU, which brings a diminution of more than 99% for whole the drying temperatures (Figure 6). There are any existing significant differences between the different drying modes on the turbidity of water after 72 hours of decantation with 100 mg / l of M. oleifera.

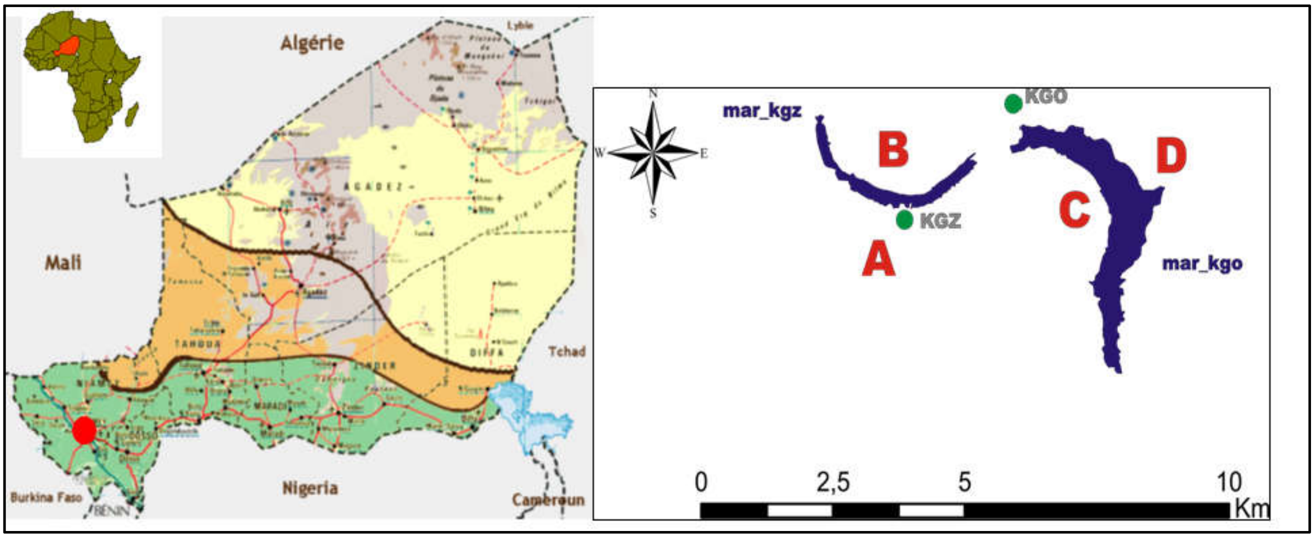

Figure 1. Localization of the parts Kongou Gorou Zarmagandey pool (mar_kgz) and Kongou Gorou (mar_kgo) pools (Salifou, 2004)

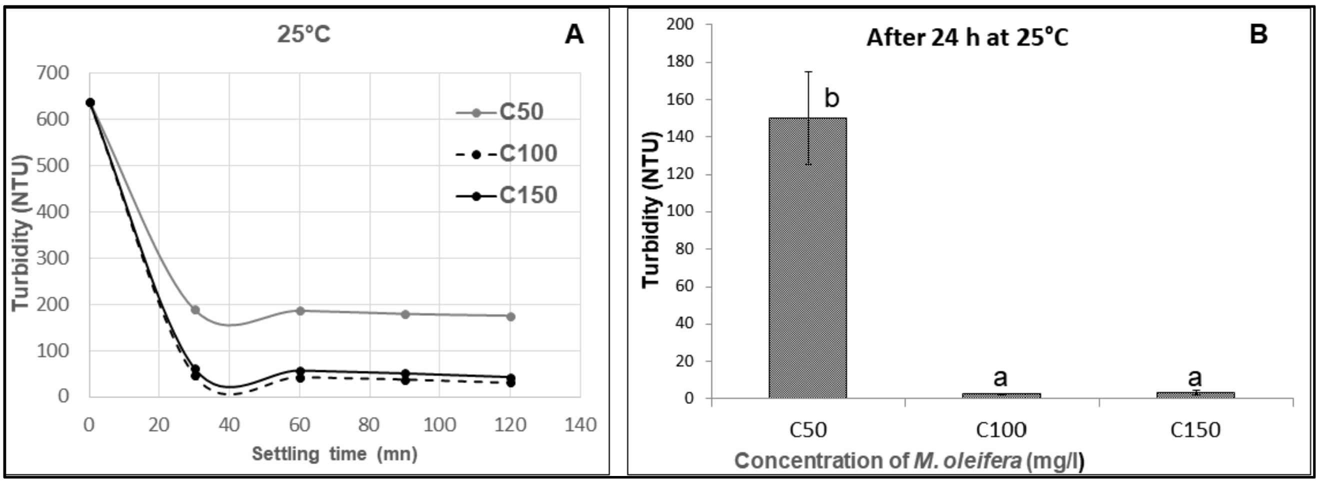

Figure 2. Influence of *M. oleifera* powder stock at 25 ° C on the turbidity of Kongou Gorou Zarmadandey (KGZ) pool water in function of the time of decantation. The averages affected by the same letter are statistically homogeneous according to the Fisher's test of sill of 5%

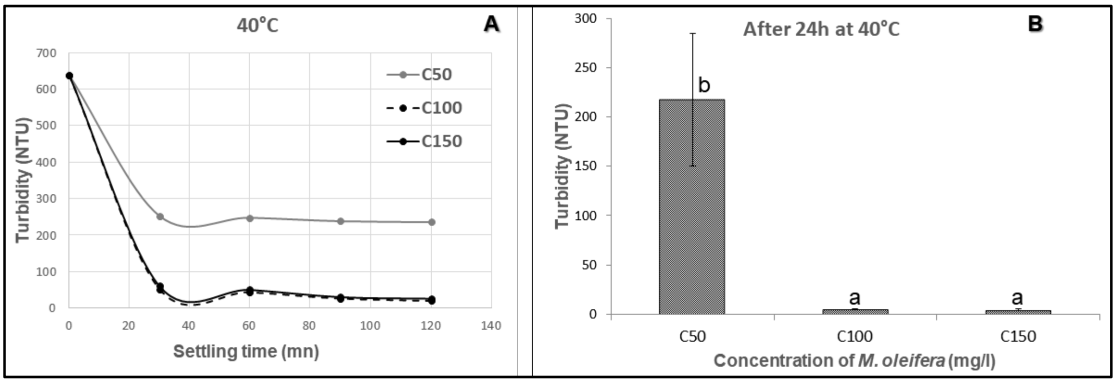

Figure 3. Influence of the M. oleifera powder stocked at 40 ° C on the turbidity of the water of the KGZ pool in function of the time of decantation. The averages in histograms affected by the same letter are not statistically different according to the Fisher's test of sill of 5%

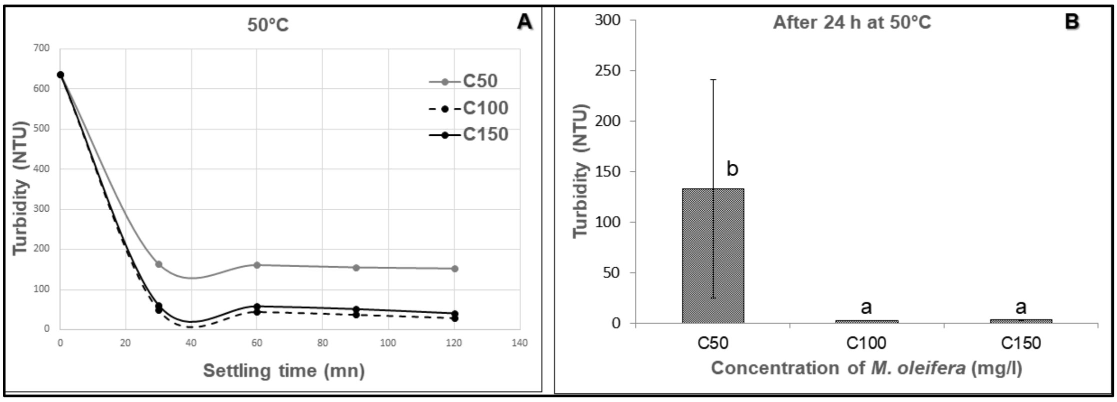

Figure 4. Influence of M. oleifera powder, stocked at 50 ° C, on the turbidity of the KGZ pool water in function of the time of decantation. The averages in histograms affected by the same letter are not statistically different according to the Fisher's test of the sill of 5%

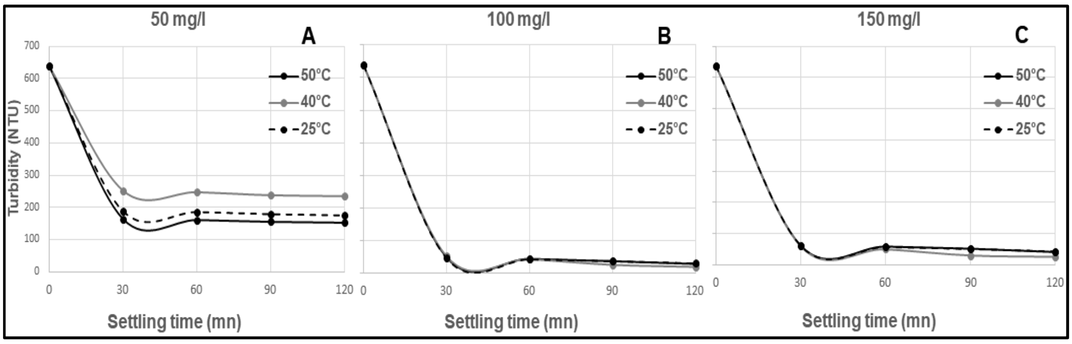

Figure 5. Temporal evolution of the turbidity of treated water with M. oleifera kernel powder according to the drying temperature of M. oleifera seeds

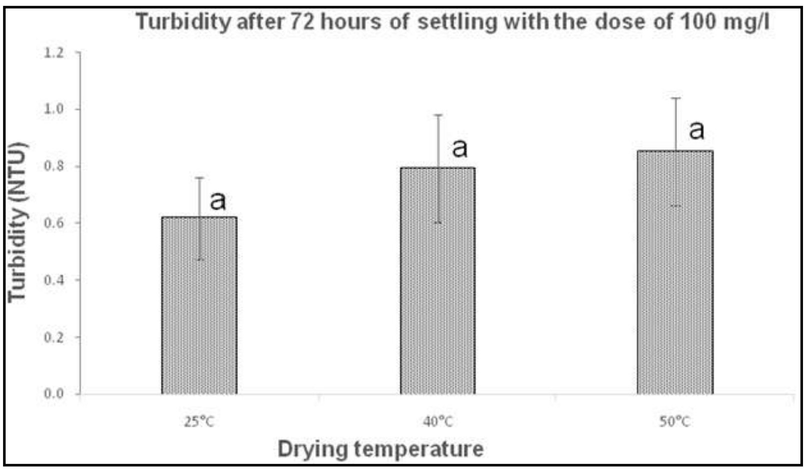

Figure 6. Turbidityof water after 72 hours of decantation with the treatment of 100 mg / l of the M. oleifera kernel dried respectively at 25, 40 and 50 ° C. The averages in histograms affected with the same letter are statistically homogeneous according to the Fisher's test of sill of 5%

The turbidities obtained with the three doses, although they are homogeneous, however one can certifya smallraising in the water turbidity with the drying temperature: 0.62 NTU with the powder dried at 25 ° C against 0.85 NTU with the powder of kernel of M. oleifera dried at 50 ° C.

DISCUSSION

Inflection of M. oleifera's dose on the turbidity of water: The initial turbidity of the beast water (638 NTU) decreases with the time of decantation after treatment with M. oleifera kernel powder for the three doses applied. The turbidity diminution of water is significant from 30 minutes of decantation for whole the doses and with any type of the drying temperature of the M. oelifera kernel we can mark the diminution of 75, 92 and 90% of initial turbidity after 30 minutes of decantation respectively with 50, 100 and 150 mg / l M oleifera for whole temperatures. Our results are different from those of Okoyi *et al*. (2014), who obtained the diminution of 43% with thetime of decantation of 24 hours for a treatment dose of 100 mg / l. This difference would come from the initial turbidity of water which is 58 NTU (weak) for the Okoyi sample and 638 NTU (strong) for our sample. We deduced then in certifying that the optimal doses are functions of the initial quality of water and that the water of weak turbidity are difficultly flocculate (Faby and Eleli, 1993).

According to Birkner and Morgan, (1968), the increasing in available hanging particle for adsorption and the formation of inter-particular bridge in a water sample with strong initial turbidity can contribute to a highest efficiency of the turbidity elimination. The results obtained corroborant those of several authors (Diallo, 2008; Kaboré *et al*., 2013) those who certify that, for all the concentration of M. oleifera, the clarification of waters is quick during the first thirty minutes, followed with a slow decantation after one hour. This diminution of the turbidity of water is more important with the concentrations of 100 and 150 mg/l than with the dose of 50 mg/l especially from 30 minutes of decantation and for whole the drying temperatures. The values of the turbidity obtained before 2 hours are all more superior than the WHO (2011) which is of 5 NTU. On contrary, after 24 hours, the corresponding values of doses of 100 and 150 mg/.l-1are whole inferior to 5NTU so it conforms to the norm of WHO (2011). After 24 hours of decantation; the turbidity of treated water is significantly more elevated with the dose of 50ml/g than with the others dose of (100 and 150mg/l) of oleifera M. for whole the temperatures. After 24 hours of decantation, the turbidity of treated water is of 150.2, 2.6 and 3.5 NTU respectively with the dose of 50, 100, and 150 mg/l of dried oleifera M. kernel at 25°C. However, the difference is not significant between the 100 dose and which of 150mg/l of oleifera M. on the turbidity of treated water for whole the drying temperatures. This is understandable that the dose of 100mg/l is the optimal dose for the clarification of the pool water per the kernel of oleifera M.

Influence of M. oleifera kernel drying mode on the turbidity of water: The mode of drying of M. oliefera kernel, especially the temperature, has an influence on the clarification of water by M. oleifera particularly with the dose of 50 mg / l. Indeed, with this dose of 50 mg / l, the diminution the turbidity of water is more elevated with the M. oleifera kernel powder dried at 25 and 50 ° C (respectively 76 and 79% after 24 hours of decantation) than with the kernel dried at 40 ° C (65% after 24 hours of decantation). Our results are different from those of Katayon *et al*. (2005) who obtained a turbidity diminution of treated water with the seeds powder of Moringa oleifera goes 60%. This difference will due on drying condition, in their case, the seeds have been stocked during one month in an open recipient and one is closed in an ambient temperature of 28° C.

As far as the other doses (100 and 150 mg / l), the drying temperature of kernel has no influence on the variation of the turbidity of treated water. However, after 72 hours of decantation, there are any existing significant differences between the different drying temperatures on the turbidity of the water with the dose of 100 mg / l of M. oleifera.

Conclusion

This study tested the influence of M. oleifera kernel powder on the clarification of pool water for drip to drip irrigation. Moringa oleifera kernel powder allowed to abase significantly the initial turbidity of beast (638 NTU) to 74, 99 and 99%, respectively, with the dose of 50, 100 and 150 mg / l after 24 hours of decantation. The dose of 100 mg / l of dried M. oleifera 25 ° C is the optimal dose for clarification of Kongou Gorou Zarmagandey's pool waters. The treatment with the kernel powder of M. oleifera is an efficient method, simple and easy-to made in work for clarifying the troubles of pool water and then being usable for the drip to drip irrigation system. Indeed, water in order to become suitable for drip to drip irrigation, must have a turbidity of 5NTU in maximum as recommended by WHO. However, this obtained turbidity will improve after a certain time of decantation of 72 hours. The effectiveness of the treatment depends more on the dose of powder. However, further complementary works can be envisaged for studying the impact of M. oleifera kernel powder on the chemical and bacteriological quality of water obtained after treatment.

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