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Effect of the "rebirth to seven wonders" powder supplement for nutritional management in HIV-infected subjects on antiretroviral therapy

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The rebirth to seven wonders (R7M) powder supplement was used for nutritional management of HIV-infected patients. The powder is a multipurpose powder used as a food supplement in human foods because of its nutritional qualities. It has many uses such as in the fight against malnutrition in Côte d'Ivoire because of its nutritional qualities. The purpose of this study was to evaluate the effect of supplementation of the "R7M" powder consumption on the clinical evolution and the laboratory findings in people living with HIV/AIDS and on antiretroviral treatment. The present work is focused on biochemical analysis and monitoring of some anthropometric and laboratory parameters. The biochemical analysis of the powder showed that 100 g of powder contains 54.02 g of carbohydrate, 7.6 g of fat and 31.25 g of proteins. The same amount of powder contains minerals such as magnesium (149.25 mg), calcium (77.5 mg), zinc (3.25 mg) and iron (47.5 mg). After six months of using the "R7M" powder among both groups, anthropometric parameter (weigh) and biological parameters (creatine, hemoglobin and CD4 count) were measured. Nutritional recovery with the "R7M" powder showed an improvement in the main follow-up criteria, that is, weight, hemoglobin, creatine and CD4 count in both groups. This improvement was significantly increased in HIV group with antiretroviral (ARV) treatment. This study confirms the nutritional properties of the "R7M" powder which can be used as food supplement in the fight against protein-energy malnutrition and micronutrient deficiencies.

Key words: Powder, rebirth to seven wonders, nutrition, HIV, food supplement.

INTRODUCTION

Côte d'Ivoire is one of Africa's sub-Saharan countries most affected by HIV infection with a seroprevalence of about 3.9% according to national plan of AIDS fighting (UNAIDS, 2014). Despite a remarkable commitment of political and civil society in the care (medical, psychological and social) of people living with HIV, nutritional support is still limited. However, the nutritional care of PVVIH by adequate food could bring more improvement of the health status of these patients (Chlebouski, 1985). HIV infection coexists with

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malnutrition. Indeed, HIV progressively weakens the immune system and malnutrition itself can also increase susceptibility to infections. The energy deficit in patients with HIV/AIDS results from direct effects of HIV, opportunistic infections, reduced food rations, poor intestinal absorption and increased energy expenditure. The presence of the infection and other opportunistic diseases increase the needs of the organism with nutrients while decreasing the rate of absorption. Many infections reduce appetite.

Therefore, malnutrition can damage the function of an organ, regardless of weaken immune function, compromising the effectiveness of drugs and reduce the quality of life of the patient (Anabwani et al., 2005). It has been widely demonstrated that an infection of HIV is associated with lower serum levels of nutrients. However, immune function is highly dependent on nutritional status. Macronutrients play an important role during the HIV infection. Protein-energy deficiency can cause malfunctions of cellular immunity. Micronutrients such as vitamins and minerals are important indicators for measuring the nutritional status of man and also have a direct effect on immune functions. The deficit of these micronutrients is associated with a reduction in the number of immune cells that can cause a disorder of the immune function (Gomo et al., 2003).

However, a separate administration of each macronutrient and micronutrient to a patient is tedious given the large number of nutrients used as supplements in the treatment of PVVIH. The use of the rebirth to seven (7) wonders (R7M) powder can be more simple and convenient as it combines minerals, macro and micronutrients. Powder R7M has various important biological and nutritional activities due to the high concentration of natural nutrients. The ‘‘R7M’’powder is made with local cereals and leguminous plants which is used in infants with malnutrition. It enables the stimulation of immune system in HIV patients (Lipipun et al., 2003). It can also be produced in an artisanal way and at an affordable cost. The benefit of supplementation of the "R7M" powder lies in the potential health and economic benefits to restore the nutrition gap.

The goal of this study was to assess some biochemical characteristics and the effect of consumption of the “R7M” powder as food supplement by HIV-infected persons who were under ARV treatment at the Military Hospital of Abidjan (HMA) in Côte d’Ivoire. The nutritional quality of this “R7M” powder was specifically evaluated by determination of its biochemical constituents and measuring the anthropometric parameter (weight) and the biological parameters (creatine, hemoglobin and CD4 count).

MATERIALS AND METHODS

Vegetal material

The vegetal material used in this study was the “R7M” powder obtained with local cereals and leguminous plants.

Population and sample

The study was carried out from April to September 2014 in HMA. This study sample of 120 HIV-infected subjects of both sexes aged over 18 and were then separated into two equal groups: one with indications for ARV treatment and the other with none. Inclusion criteria were used in this study for all patients seropositive for HIV. Subjects who has been taking this powder supplement based on procedures of the study were at least 18 years of age with documented HIV infection and provided informed consent materialized by signing a form drawn up for this purpose. They have evidence of HIV pain, and they did not have tuberculosis, and have an observing ticket on them six months after the study. Exclusion criteria were patients under 18 years with related conditions (heart disease and cancer) or who have violated the protocol.

Blood sampling

Venous blood samples were drawn after an overnight fast of at least 8 to 10 h, in 5 ml EDTA. Samples were centrifuged at 3000 rpm for 10 min in dry tubes and stored at 4°C for the different analysis. After centrifugation of the blood, the plasma was collected in EDTA tube.

Methods

Determination of nutritional value of the “R7M” powder

The moisture and ash content of the powder “R7M” were determined respectively according to BIPEA (1995) and Kim and Lee (2003) methods. The mineral composition (magnesium, zinc, iron and calcium) was determined by Atomic Absorption Spectrophotometer Solaar S2 (Thermo Electron Corporation, Orion, England).

Reducing sugars in turn were extracted and assayed according to the method of Bernfeld (1955) while the total protein was assayed by the Kjeldahl method (AOAC, 1995). The lipid assay was performed by the AOAC method (1995) using a soxhlet apparatus.

Anthropometrics parameters

Body weight was measured to the nearest 100 g with subjects in light clothing and without shoes, per month during six (6) months, using a portable electronic scale of 150 kg capacity (Seca 803 Clara Scale).

Biological parameters

An assay of creatine was measured using jaffé’s kit “creatinina, (ref 100 11 11). Haemoglobin (Hb) was directly measured in the field on a drop of whole blood using HemoCue® (Hemocue HB 201+, Angelholm, Sweden). The counting of the CD4 count was done by using the FACS Count technics and reagent (Becton Dickinson, San Jose, CA).

Statistical analysis

Data were analyzed using XLSTAT 7.5.3. Comparisons between means were performed using Student t test. The level of statistical significance was P value <0.05.

Table 1. Nutritional value of the "R7M" powder g/100 g expressed in g/100 g MS.

Nutriments	Teneur (g/100 g de MS)
Water	5.73±0.3
Carbohydrate	54.02±0.2
Lipid	7.60±0.2
Protein	31.25±0.3
Ashes	1.34±0.3
Minerals	
Mg (mg)	149±0.06
Ca (mg)	77.5±0.08
Zn (mg)	3.25±0.04
Fe (mg)	47.5±0.05

RESULTS

Biochemical composition of "R7M" powder

The powder R7M components are recorded in Table 1. The analysis of the "R7M" powder revealed 5.73% of water, 31.25 g/dry matter (MS) 100 g of protein, reducing sugars, in 7.6 g lipids/100 g of dry matter (MS) and 1.34 g/100 g of ash. The micronutrients are magnesium, calcium, zinc and iron with respective content of 149 mg/100 g of dry matter (MS); 77.5 mg, 3.25±0.04 mg and 47.5±0.08 mg per 100 g of product (Table 1).

Anthropometrics parameters

Data are shown on Figure 1. It was noticed during the recovery period that the weight increased between the two groups of patients. Nevertheless, it was significantly increased in HIV-positive patients with indication of ARV treatment. These histograms indicate that after six (6) months, the average weight of patients without treatment was the lowest, 58.92 ± 10.06 kg while the weight of those receiving ART + flour have the highest average (65.21 ± 9.4). This observed increase is more significant in patients on ARV + flour that than those on only ARV.

Assay of creatine

The result is shown in Figure 2, we denote at the beginning of the treatment with "R7M" flour that the creatinemia mean was 9.4 mg/l in both groups. Six months after the flour supplementation, it was noticed that creatine was decreased in both groups. Moreover, there was a significant decrease in the group of infected-patient who were under ARV treatment.

Assay of haemoglobin

Follow-up of hemoglobin's assays is presented in Figure 3. Concerning hemoglobin, it was higher in the group that received powder R7M supplement.

Count of lymphocyte CD4

The CD4 count of infected-patients was increased in both groups during the six-month consumption of "R7M" powder supplement. Moreover, the CD4 count was significantly increased in the group that received "R7M powder" and the ARV treatment (Figure 4).

DISCUSSION

Biochemical analysis

Biochemical analysis has shown that the R7M powder contains 5.73% of water; this quantity of water is due to the type of drying of grains and legumes and the method used during the drying and milling of grains. François in 1988 showed that drying and milling are two steps that strongly affect the powder water content and a small amount of water contribute to conservation of powder during a long time and does not permit micro-organisms proliferation. The high amount of proteins in the R7M powder (31.25 g) is close to that of to the Moringa powder, it used as supplement for HIV-infected patients (Amivi et al., 2012). The amount of protein in the "R7M" powder is very important for HIV-infected because according to FANTA (2004), HIV-infected patients often suffer from protein-energy malnutrition caused by inadequate consumption or food poor in protein and energy (World Bank, 2009). Protein is important because the body cannot synthetize them. They must therefore be introduced through food. Unfortunately, actual data are not sufficient to advise or not to boost protein amount in HIV-infected patients. It is therefore caution to use protein supplement (OMS, 2008).

Results show that the powder contains an amount of carbohydrate (54.02 g); this rate is higher than that of spiruline (12 g) used as supplement for infected HIV-patients (Yamani et al., 2009). This amount would be important to fill the lack of energy of HIV-patients who because of the disease are weak (World Bank, 2009; Banda et al., 2009). Also, note that the reducing sugar content may be due to the milling stage. Indeed, the heat generated during this step is responsible for the hydrolysis of a part of the starch into simple sugars (Francois, 1988). According to François, the quality of reduced sugar in a flour is due to the grinding technique used. Our work has a linked with that François since the grinding technique has been used to obtain the flour R7M. Thus reducing sugars being directly assimilated would be easy for PVVIH to assimilate to benefit from the energy they produce. HIV-infected patients and healthy persons need in fact are same. But a daily supplement is required for patients who are under ARV treatment or underfed (WHO, 2008).

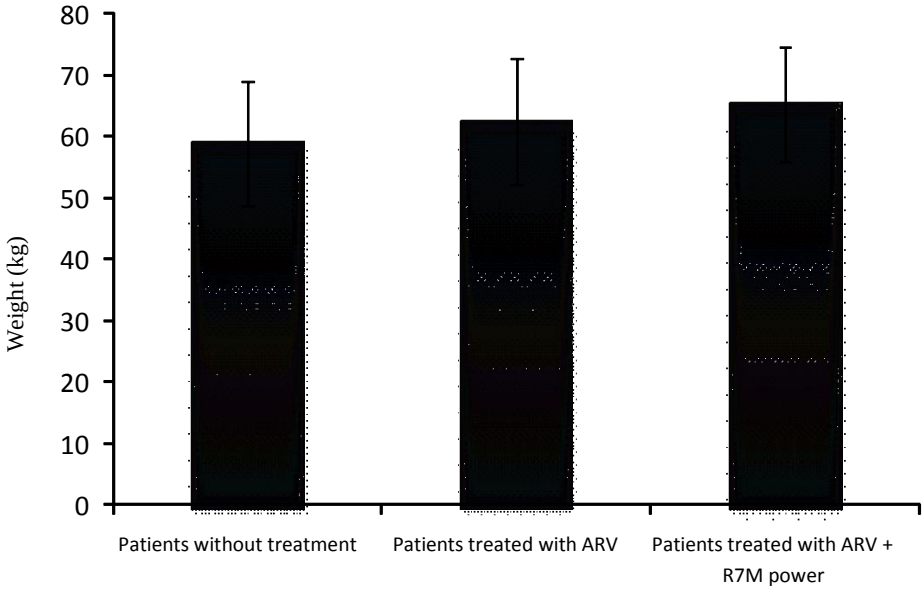

Figure 1. Evaluation of the average weight of patients.

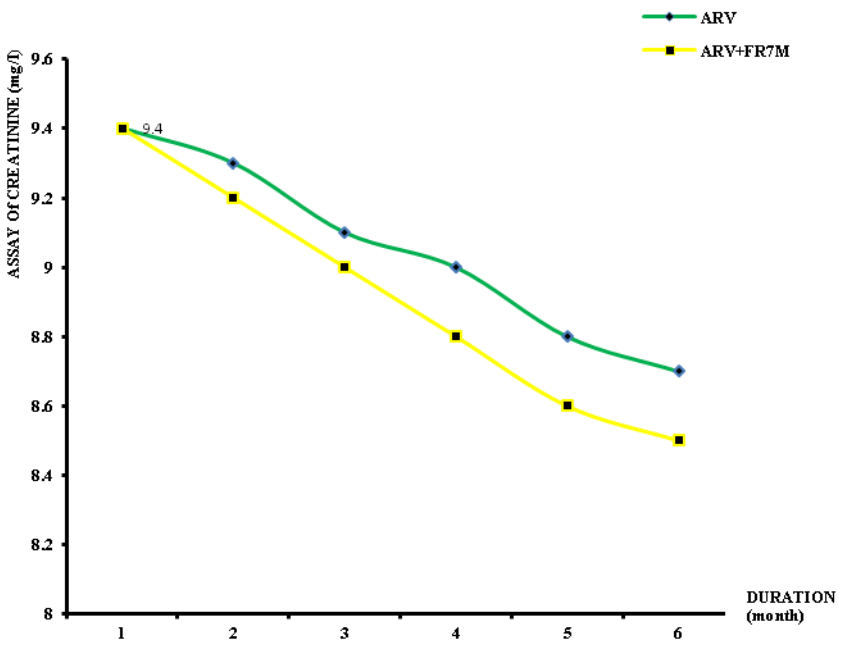

Figure 2. Improvement of creatine assays mean of patients.

The R7M powder content in fat is 7.6 g; it is close to the spirulina (7 g) used as supplement in Bangui (Yamani et al., 2009). It could contribute to energy producing in the body (Banda et al., 2009). This small amount of fat could be necessary for HIV-infected patients under ARV treatment and suffering from metabolic disturbance, because they could need less energy provided from fat (World Bank, 2009). Fat needs of patients with HIV/AIDS in no way differ from those of healthy people (WHO, 2008). PHAs have additional energy requirements due to HIV, opportunistic infections of malabsorption of nutrients. These needs vary between 10 and 30% depending on whether the subject is asymptomatic or not (World Bank, 2009). This amount would be important to fill the lack of energy of HIV-patients who because of the disease are weak (World Bank, 2009; Banda et al., 2009). The

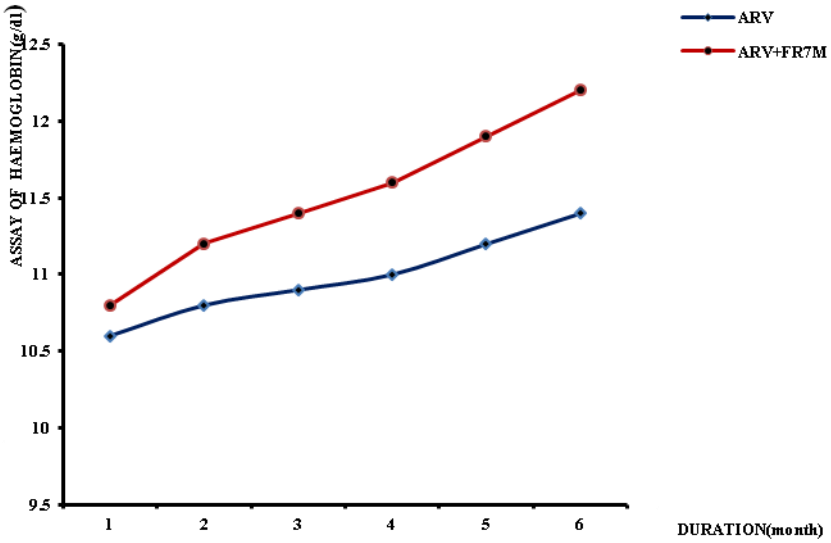

Figure 3. Improvement of mean hemoglobin in patients.

deficiency of micronutrients like Mg, Zn, Ca, Fe, P, etc was observed in infected HIV-patients (Kupka, 2002). It is true that many variations were not really known but it known that lack of micronutrients destroy cells ((Banki et al., 1998). The R7M powder contains important minerals such as Zn, Ca and Fe (Banda et al., 2009). The amounts of Fe (47.7 mg) and Zn (3.26 mg) of this powder are higher than that of the Moringa powder, which are respectively of 20 and 2.6 mg. There is no significant difference between the Mg and Ca of the both powders of Moringa and R7M. These different micronutrients are very essentials for HIV-infected persons because the lack of these nutrients on their organism leads quickly to AIDS and death (Piwoz and Preble, 2000).

Evolution of anthropometric and biological parameters

Body mass index and nutritional status

The measurement of body mass index reflecting the nutritional status at the AIDS stage, weight loss is often associated with malabsorption, anorexia, opportunistic infections and metabolic disorders (Young, 1997). After six months of supplementation of “R7M”, nutritional recovery in antiretroviral treatment group was higher than those who took only the anti-retroviral treatment (Figure 1). The most significant weight gain observed in patients administering ARVs and R7M flour could be explained by the fact that for the high-energy and protein in this meal, nutrients is necessary for PLHIV for maintenance of weight gain (Piwoz and Preble, 2000). With administration of 5 g/d, the R7M is a dietary supplement rich in protein and also microelement (zinc and iron) that would provide enormous benefits.

It would allow a renewed appetite and nutritional rehabilitation. Simporé et al. (2005) in Burkina Faso had also observed a nutritional recovery in children under 5 years supplemented with spirulina for 6 weeks with a weight gain of 25 g/day. A comparative nutritional rehabilitation study not only demonstrates the interest of spirulina in treatment of children malnutrition but also its particularity favorable impact on the renutrition of children infected by HIV. R7M used for the rehabilitation of people living with HIV which is plant origin like spirulina. By restoring the metabolism and the physiological disturbances, “R7M” contribute significantly to improving the patient's physical condition. PHAs treated with ARV drugs can increase significant weight loss. Indeed, increased weight shows improved clinical disease. Moreover, some ARV-based treatments such as protease inhibitors are involved in dyslipidemia (World Bank," 2009). This results in a deposit of fat in the body and a body weight gain without effective control of HIV. Optimal viral suppression by antiretroviral therapy, could help restore the immune system and the removal of intestinal malabsorption (Carbonnel et al., 1998). This explains the body weight gain of patients on ARV treatment. As for the weight loss of patients infected with HIV/AIDS, this is frequently associated with an increase in viral load and/or decrease in CD4 lymphocytes.

Biological parameters

After six months of R7M supplementation, the decrease in the blood concentration of creatinine in antiretroviral treatment group was more significant than those who took only the anti-retroviral treatment (Figures 2, 3, 4).

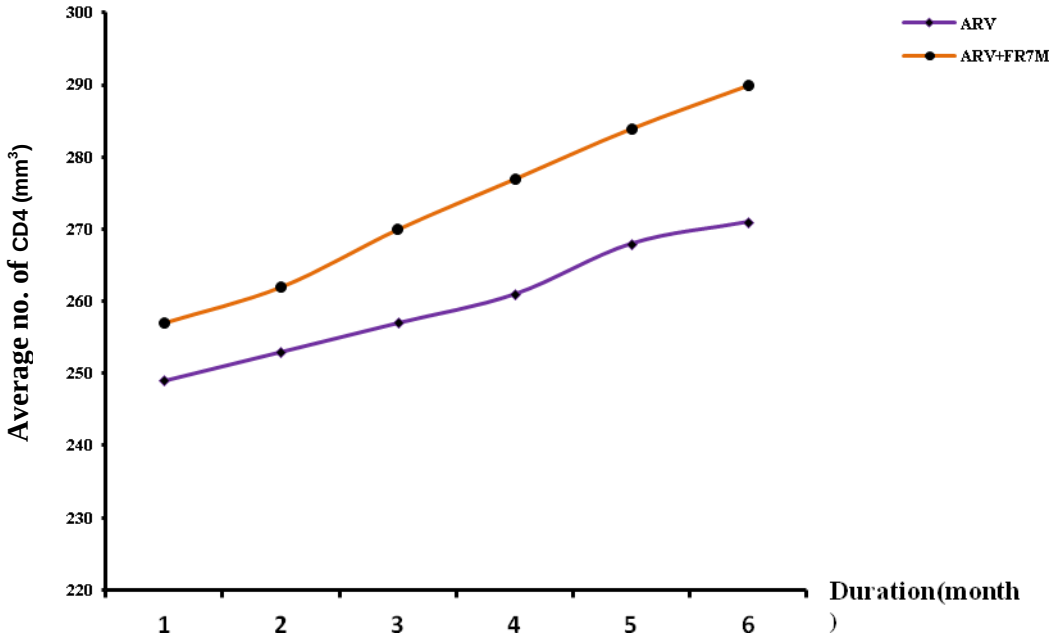

Figure 4. Improvement of CD4 count's mean.

This shows that the consumption of the R7M power did not induce disturbance of kidney function. The increase of creatinine in the blood is indicative of kidney failure which can be mild or severe, acute, transient or chronic. A cast of muscle associated with severe malnutrition may lead to an increase of creatinina.

Treatment of patients with ARV shows a loss of creatine which would mean the improvement of glomerular filtration with HIV-infected patient which is due to ARV utilization (Nyimi et al., 2001). However, the use of ARV treatment coupled with the "R7M" power, showed a significant decrease of creatine in patients' blood. This could be explained firstly by the fact that the consumption of the R7M power did not cause disturbances in kidney function. The decrease could be explained by the fact that the R7M powder with its high protein content could participate in refeeding patients by increasing their muscle mass (Anwar et al., 2007). The increase of creatinine in the blood is indicative of kidney failure which can be mild or severe, acute and transient or chronic. A cast of muscle associated with severe malnutrition may lead an increase of creatinina. Treatment of patients with ARV shows a loss of creatinemia and that would mean the improvement of glomerular filtration with HIV-infected patient which it due to ARV utilizing (Nyimi et al., 2001). However, the use of ARV treatment coupled with the "R7M" power showed a significant decrease of creatinina in patients' blood. This could be explained firstly by the fact that the consumption of the "R7M" power did not cause disturbances in kidney function.

Regarding the concentration of hemoglobin at the start of the study, it was 32.3% (31/96) of patients taking "R7M" anemic against 34.74% (33/96) taking only ARVs. After six months of supplementation, it could be observed that the percentage of anemic patients on ARVs remained static, 33.72% (29/86) while it increased in the group treated only with ARVs. This increase is more significant in patients treated with ARV and supplemented with R7M flour. The causes of anemia may be due to iron deficiency and/or folic acid deficiency (Grinspoon et al., 1998).

Indeed, these two microelements which are iron and vitamin B12 are key compounds for the synthesis of hemoglobin. The presence of iron in the flour, may participate in the synthesis of the hemoglobin molecule responsible for the delivery of oxygen to all parts of the body (Connor, 2000; Banda et al., 2009). The R7M appear to be a good supplement because it contributes its richness in iron and folic acid to decrease the level of anemia. Alverez et al. (2005) showed that the use of zidovudine in intensive therapy associated with ribavirin for the treatment of HCV in patients infected with HIV reduced hemoglobin.

As for the CD4 cell count, the results showed that the R7M contribute to an increase in CD4 count. Indeed R7M is a good source of b-carotene (which is converted to vitamin A), but also in minerals (zinc magnesium). These micronutrients have a positive effect on cellular immune system. Thus, the significant increase in CD4 cell counts in patients treated with ARV and R7M flour could be explained by ARVs that would allow optimum control of the virus, an increase in CD4 count (Carbonnel et al., 1998) and nutrients as flour could improve the rate of CD4 patients (Muller et al., 2000). Note that HIV destroys

the immune system by infecting the CD4 lymphocytes and antigen presenting cells. Thus, the measurement of CD4 lymphocytes is an essential parameter monitoring; a very low rate would indicate an advanced stage of the disease and the immune defense mechanism. Similar findings were reported in Tanzania by Fawzi et al. (1998, 2004). The decrease in CD4 count may be due to the increased oxidative stress, apoptosis and syncytia formation (Kotler et al., 1998; Bogden et al., 2000).

A significant improvement of weight was noticed in HIV-infected patients who were under ARV treatment. It showed that there is an improvement in recovery. In fact, the loss of weigh in HIV-infected patients is due to the lowering of the CD4 count in their body. An optimal deletion of HIV virus by the ARV treatment restores the immune system and the deletion of intestinal malabsorption. This explains the increase in weight of infected patients who were under ARV treatment.

The significant improvement of weight in HIV-infected patients under ARV treatment and supplement of “R7M” powder is explained by high amount of energy and proteins of this powder, which necessary nutrient for HIV-infected patients to maintain wellbeing (Piwoz and Preble, 2000).

And secondly, this decrease could be explained by the fact that the R7M flour with its protein content could contribute to a refeeding of patients (Anwar et al., 2007). With regards to the concentration of hemoglobin, there is an increase in both groups of patients, but the increase is more significant with patients with indication of ARV treatment and the “R7M” power. This can be linked on one hand to fatty acids and the other to iron which is present in the flour. This contribution afterwards in the synthesis of the hemoglobin’s molecule is responsible for carrying oxygen in all the parts of the body (Connor, 2000; Banda et al., 2009).

HIV destroys the immune system by infecting CD4 count and cells which have antigen. The CD4 count is an essential parameter. And the significant increase in the number of lymphocytes, CD4 count in patients treated with ARV treatment and the “R7M” flour could be explained by ARV treatment which will cause optimum virus-control destruction, in opposition to an increase in CD4 cells (Carbonnel et al., 1998) and secondly with the flour and its nutrient help in the improvement of CD4 patients’ count (Muller et al., 2000).

Conclusion

In this study, it was noted that the biochemical analysis of the “R7M” power has a high content of proteins and carbohydrates, thus containing important minerals such as Zn, Mg, Ca and Fe. These essential components for the immune system, are necessary for the development of non-specific immunity and cell-mediated, especially, CD4. Magnesium is important in protein synthesis; Iron is necessary for all the cells which provide energy and calcium is needed for strong bones and normal functioning of muscles and nervous system. The study on the effect of “R7M” power supplement in recovery of HIV-infected patients after six (6) months showed an improvement in follow-up criteria: weight, creatine, hemoglobin and CD4 count. The significant result is higher among the group with indication for ARV treatment and consumption of the “R7M” power.

All this shows that a meal with “R7M flour” has nutritional and pharmacological qualities in the fight against protein-energy malnutrition and micronutrient deficiency in PV/HIV. Despite the profound metabolic disturbances caused by viral infection, the R7M power helps in nutritional recovery among HIV-infected patients.

Conflict of Interests

The authors have not declare any conflict of interests.

REFERENCES

Anabwani GMB, Navario CBP (2005). Nutrition and HIV/ AIDS in sub-Saharan Africa: an overview. J. Nutr. 21:96-99.

Alverez D, Dieterich DT, Brau N, Moorehead L, Ball L, Sulkowski M S (2005). Zidovudine use but not weight-based ribavirin dosing impacts anaemia during HCV treatment in HIV-infected persons. J. Viral Hepat. 13(10):683-689.

Amivi TB, Marie-Luce AQ, Koko L, Kouami K, Messanvi G (2012). Nutritional recovery in malnourished patients HIV positive and HIV negative after using leaves Moringa oleifera Lam. J. Anim. Plant Sci. 15(2):2184-2199. http://www.m.elewa.org

Anwar F, Latif S, Ashraf M, Gilani AH (2007). *Moringa oleifera*: a food plant with multiple medicinal uses. Phytother. Res. 21(1):17-25.

Banda NP, Husken SMC, Kaunda W (2009). L’impact de la nutrition et de la supplémentation en poisson sur une réponse aux traitements antiretroviral, Zambie. pp. 1-27. http://pubs.iclarm.net/resource_centre/WF_2574.pdf

Banki K, Hutter E, Gonchoroff NJ (1998). Molecular ordering in HIV-induced apoptosis. Oxidative stress activation of caspases, and cell revival are regulated by transaldolase. J. Biol. Chem. 273(19):11944-53.

Bogden JD, Kemp FW, Han S, Bruening K, Denny T, Oleske lM, Lloyd J, Baker H, Perez G, Kloser P (2000). Status of selected nutrients and progression of human immunodeficiency virus type 1 infection. Am. J. Clin. Nutr. 72:809-815.

Carbonnel F, Maslo C, Beaugerie L, Carrat F, Wirbel E, Aussel C, Gobert JG, Girard PM, Gendre JP, Cosnes J, Rozenbaum W (1998). Effect of indinavir on HIV-related wasting. AIDS 12(14):1777-84.

Connor WE (2000). Importance of n-3 fatty acids in health and disease. Am. J. Clin. Nutr. 71(1 Suppl):171S-175S.

Chlebowski RT (1985). Significance of altered nutritional status in acquired immune deficiency syndrome (AIDS). Nutr. Cancer 7(1-2):85-91.

Association of official analytical chemist official, methods of analysis (AOAC) (1995). Association of official analytical chemist official, methods of analysis (15thed). wd. 542 p.

Banda ND, Hüsken SMC, Kaunda W (2009). The Impact of Nutrition and Fish Supplementation on the Response to Anti Retroviral Therapy, Zambia. A literature Review. Regional Programme Fisheries and HIV/AIDS in Africa. Project report published by World Fish Center. http://pubs.worldfishcenter.org/resource_centre/WF_2512.pdf

Banki K, Hutter E, Gonchoroff NJ (1998). Molecular ordering in HIV-induced apoptosis. Oxidative stress, activation of caspases, and cell survival are regulated by transaldolase. J. Biol. Chem. 273(19):

11944-11953.
Bernfeld P (1955). Amylases, α and β. Methods in enzymology. (9thed) Academic press, Inc, New York. pp. 149-158.
Piwoz EG, Preble EA (2001). HIV / AIDS and nutrition: a review of the literature and recommendations for nutritional care and support in sub-Saharan Africa. http://www.popline.org/node/176956
Food and Nutrition Technical (FANTA) (2004). HIV/AIDS: A Guide for Nutritional Care and Support. 2ème édition Washington D.C.: Academy for Educational Development. http://www.aidsdatahub.org/sites/default/files/documents/HIV_AIDS_A_Guide_for_Nutritional_Care_and_Support_2004.pdf.pdf
François M (1988). From grain to flour, milling and husking in West Africa. Collection 'stock of technology' CTA (altersial). GRET, Paris. 279 p.
Grinspoon S, Corcoran C, Miller K, Wang E, Hubbard J, Schoenfeld D, Anderson E, Basgoz N, Klibanski A (1998). Determinants of increased energy expenditure in HIV infected women. Am. J. Clin. Nutr. 68:720-725.
Kupka R, Fawzi PW (2002). Zinc nutrition and HIV infection. Nutr. Rev. 60(3):69-79.
Kotler D, Heymsfield SB (1998). HIV infection: a model chronic illness for studying wasting diseases. Am. J. Clin. Nutr. 68(3):519-520.
Lipipun V, Kurokawa M, Suttisri R, Taweechotipatr P, Pramyothin P, Hattori M, Shiraki K (2003). Efficacy of Thai medicinal plant extracts against herpes simplex virus type 1 infection *in vitro* and *in vivo*. Antiviral Res. 60:175-180.
Muller F, Svardal AM, Nordoy I (2000). Virological immunological effects of antioxidant treatment in patient with infection. Eur. J. Clin. 30:905-914.
Simpore J, Zongo F, Kabore F, Dansou D, Bere A, Nikiema JB, Pignatelli S, Biondi D, Ruberto G, Musumeci S (2005). Nutrition Rehabilitation of HIV-Infected and HIV-Negative Undernourished Children Utilizing Spirulina. Ann. Nutr. Metab. 49:373-380.
World Health Organization (WHO) (2008). Nutrient requirements for people living with HIV / AIDS: Report of a technical consultation. ISBN 978-92-4-259119-4.
World Bank (2009). International HIV / AIDS, Nutrition and Food Security. Summary of recommendations: improve the results of the fight against HIV / AIDS through support to nutrition. 86 p.
Yamani E, Kaba-Mebri J, Mouala C, Gresengue G, Rey JL (2009). Use of spirulina supplement for nutritional management of HIV-infected patients: Study in Bangui, Central African Republic 69:66-70. Med. Trop. Rev. Corps de Sante Colon. 69(1):66-70.