

Supplements Effect of Virgin Coconut Oil and Albumin Capsules (Catfish protein) on TB Patients Receiving Multi Drugs Therapy-DOTS Strategic in BBKPM Makassar, Indonesia

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Abstract-Pulmonary tuberculosis is a global problem requiring 6-month MDT-DOTS continuous treatment. This time based treatment along with the combination of VCO nutritional supplement and/or Catfish-extracted albumin has shown a significant benefit on improving immune response, accelerating the conversion of BTA sputum, increasing nutritional states and improving chest X-ray imaging in people with active pulmonary TB. This study aimed to compare the changes in pulmonary TB patients treated MDT-DOTS combined with supplemented VCO and/or albumin with that in the MDT-DOTS placebo group. The experimental study was designed by using two pre and post test groups with double blind randomized controlled trial. Eighty (80) participants met with study inclusion and were randomly distributed in the experimental groups. The study result has shown significant improvements in all observed variables among the experimental groups receiving the combination of MDT-DOTS with VCO and/or Catfish-extracted albumin. These are including *accelerating the conversion of BTA sputum* (VCO i.e. $p < 0.00$; Catfish-extracted albumin i.e. $p < 0.04$; and VCO + Catfish-extracted albumin i.e. $p < 0.00$), *increasing nutritional state* (VCO i.e. $p < 0.03$; Catfish-extracted albumin i.e. $p < 0.003$; and VCO + Catfish-extracted albumin i.e. $p < 0.01$) and *improving chest X-ray imaging* (VCO i.e. $p < 0.04$; Catfish-extracted albumin i.e. $p < 0.003$ and VCO + Catfish-extracted albumin i.e. $p < 0.001$). MDT-DOTS treatment combined VCO nutritional supplement and/or Catfish-extracted albumin capsules could accelerate the conversion of sputum smear, could improve nutritional status and improve chest X-ray imaging.

Index terms; MDT-DOTS, Supplement VCO and albumin capsules, sputum smear conversion, nutritional status, chest X-ray imaging

I. INTRODUCTION

World Health Organization (WHO) reported that pulmonary TB disease remains a global health problem because it cause the death 1.40 million. People world widely Indonesia was ranked the world's third most 242 655 cases of pulmonary TB, the incidence rate of 450 per 100,000 population, the prevalence rate of 680 per 100,000 population as well as the cause of death of 65 per 100,000 and ranks 21th out of 27 countries with high cases of MDR / XDR [1].

The principle of pulmonary TB treatments patients is anti-tuberculosis drugs and the improvement of the immune system that will add a strong function bactericid and bacteriostatic. DOTS treatment strategy to break the chain of transmission of pulmonary TB cure rate at least 85-95% [2] as well as sputum smear conversion takes an average of between 8 to 12 weeks. In Latvia DOTS treatment BTA sputum conversion rate below 12 weeks [3].

Fast time sputum smear conversion in pulmonary tuberculosis treatment is influenced by these factors: nutrition status, balanced nutrition [4, 5, 6]. Malnutrition status causes decreased immune response against TB infection in individuals lung [7, 8], so the risk of conversion failure 8.861 times greater than the normal nutritional status and pulmonary tuberculosis patients with severe malnutrition have an increased risk of conversion failure 30.918 times greater than the normal nutritional status [9].

Suppression of the immune system cellular nutritional status is less characterized by a decrease in the number of CD4 + cells and the levels of IFN- γ in patients infected with the germs of TB [10]. Cells CD4 + T very important in the continuing generation against pathogenic germs pulmonary TB by stimulating Th1 producing IFN- γ to activate alveolar macrophages [11]. Supplementing nutrients such as macro and micro albumin capsules (protein catfish) which is rich in albumin protein, essential amino acids, vitamins and minerals [12] or

Virgin Coconut Oil (VCO) of material Glycerol monolaurate (GML) effect of anti tuberculosis tb [13], anti-inflammatory [14], improve appetite and weight gain in patients with pulmonary tuberculosis infection [15].

II. MATERIAL AND METHODS

2.1 Research design

Observational study with analytical quantitative applied an approach of Randomized Quasi-Experimental with two-group pre-test and post-test control double-blind design. Population sample is a clinical diagnosis, sputum smear (+), X-Ray chest (+) and meets the criteria for inclusion, "accidental sampling method", patients visiting 1st Maret 2013 to December 31st, 2013 at BBKPM Makassar. Those 80 samples were divided into 4 groups: Group I: 20 samples, MDT-DOTS + capsule albumin (protein catfish), Group II: 20 samples, MDT-DOTS + Virgin Coconut Oil (VCO), Group III: 20 samples, MDT-DOTS + VCO + Capsules albumin (protein catfish) and Group IV: 20 samples, MDT-DOTS + placebo. Determination of the serial number of the subjects carried out by order of the visit. All patients treated with the DOTS strategy, supplemented albumin dose capsules 3 times per day and VCO 2 capsules 3 times a dose of 2 tablespoons per day, for 2 months in the control PMO (treatment supporter).

2.2 Evaluated Variables

Sputum smear

Examined early diagnosed early, then every week for 8 weeks (2 months). Specimens of sputum: any morning-when, the staining method "Ziehl Neelsen", by laboratory personnel when BBKPM Makassar. Sputum smear positive: At least 2 of 3 specimens of sputum smear positive outcome any morning-when,

1 specimen of sputum smear positive result and chest X-ray showed a picture of tuberculosis, 1 specimen any morning-when results are positive and smear-positive TB bacteria culture, one or more sputum specimens positive result after 3 sputum specimens (SPS) in the previous examination results are smear negative and there is no improvement after antibiotic treatment of non OAT. Sputum smear negative sputum specimens SPS if 3 sputum smear examination results are negative.

2.3 Nutritional status

Checking BMI (Body Mass Index) in early diagnosis for each month for 6 times the measurement (6 months), by measuring height and weight, nutrition carried out by officers in Makassar BBKPM to calculate the BMI, use scales ZT-120 "HEALTH CARE" brand "SMIC", the result is calculated BMI using the following formula:

$$\text{Body Mass Index (BMI)} = \frac{\text{Body weight (kg)}}{\text{Body height (m)}^2}$$

- 1) Poor nutrition state (IMT < 18,5)
- 2) Good nutrition state (IMT ≥ 18,5-25,0)

2.4 Chest X-ray examination and data analysis:

Chest X-ray start and end of treatment to see a picture of the lesion cavity, tubercles and fibrosis, read by a radiologist physicians in BBKPM Makassar. Management and data analysis with qualitative research program SPSS. Because categorical measurement scale (ordinal, continuous ratio and ratio of natural zero), then the use of comparative hypothesis test > 2 unpaired (Kruskal Wallis, paired T test) and a comparative test of more than 2 groups of pairs (Wilcoxon test).

III RESULT AND DISCUSSION

3.1 Population Characteristics

Table 1. Characteristics of study population base on sex, age and type of work,

Sample Characteristics		Research group				p
		DOTS+ Placebo (%)	DOTS + Albumin (%)	DOTS+ VCO (%)	DOTS+VC +Albumin (%)	
Sex	Male	65	50	55	65	0,707
	Female	35	50	45	35	
Age	15 – 24	15	19	16	14	0,958
	25 – 64	80	75	80	81	
	65 – 70	5	6	4	5	
Type of work	not working / housewife	40	35	40	40	0,825
	civil servants	0	10	5	10	
	private / entrepreneur	35	30	35	35	
	farmers / fisherman	5	10	0	0	
	The driver / Labor	5	10	5	5	
	Student	15	5	15	10	

p: Chi square test

3.2 Acceleration of AFB sputum conversion

Description of study population is analysis between independent variables in all experimental groups, significant acceleration of sputum conversion in all experimental groups i.e. MDT-DOTS+VCO group ($p=0.00$); MDT - DOTS + albumin capsules (Catfish protein) group ($p=0,004$) and MDT-DOTS + VCO plus albumin capsules group ($p=0.00$), but not in MDT-DOTS placebo control group ($p=0.068>0.05$).

Analysis of the most powerful treatment groups to accelerate time AFB sputum conversion. MDT-DOTSsupplemented group albumin capsules plus VCO compared placebo has a strength of 3,8 times faster AFB sputum conversion with a significance of value $p = 0.000$. MDT-DOTS group supplemented VCO has a power of 2,1 times faster AFB sputum conversion than placebo with a significance of p value = 0.000. MDT-DOTS supplemented group albumin capsules has strength 1.4 times faster AFB sputum conversion, compared to placebo with a significance of p value = 0.004.

3.3 Improvement of nutritional state

This study shows significant improvement of nutritional state in all experimental groups i.e. MDT-DOTS+VCO group ($p=0.019<0.05$); MDT-DOTS+albumin capsules (Catfish protein) group ($p=.000<0.05$) and MDT-DOTs + VCO and albumin capsules group ($p=0.00$), but not in MDT-DOTS placebo (control group) ($p=0.083>0.05$).

Analysis of the treatment groups at the most to improve the nutrition state.MDT-DOTS supplemented group albumin capsules plus VCO has a strength 1.8 times more than placebo with a significance of p value = 0.021. MDT-DOTS supplemented group albumin capsules has strength of 0.7 times more improve the nutrition state of patients compared to placebo with a significance value of $p = 0.037$. MDT-DOTS group supplemented VCO has 0.6 times stronger improves the nutrition state of patients compared to placebo with a significance value of $p = 0.044$.

3.4 Improvement of chest X-ray imaging

The study also demonstrates a significant improvement of chest X-ray imaging in all observed experimental groups i.e MDT-DOTS+VCO group ($p=0.046<0.05$); MDT-DOTS+albumin capsules (Catfish protein) group ($p=.003<0.05$) and MDT-DOTs + VCO and albumin capsules group ($p=0.001<0.05$) while those in MDT-DOTS placebo control group does not show any significant improvement ($p=0.083>0.05$).

Analysis of the treatment groups at most repair chest X-ray imaging. MDT-DOTS supplemented group albumin

capsules plus VCO has a strength of 0.4 more compared to placebo with a significance of p value = 0.008. MDT-DOTS group supplemented albumin capsules has a strength 0.2 stronger compared than placebo with a significance of value $p = 0.012$. MDT-DOTS group supplemented VCO has a strength of 0.1 times stronger compared than placebo with a significance of p value = 0.025.

IV. DISCUSSION

4.1 Acceleration of AFB sputum conversion

Albumin capsule is proven to have positive effect on accelerating the conversion time of BTA sputum because it contains several essential amino acid, mineral (Ca, Mg, Fe, Cu, Zn, Mn, Ni and Co, Se and phosphor) as well as vitamin A, C, D, E and B complex (vitamin B12 in particular) [12].Glutamate contained in the albumin capsules will facilitate the increasing of CD4+ cytokine level. A study conducted by [16]showed that CD4+ cytokine plays a crucial role in stimulating the helper 1 cell producing IFN- γ which is subsequently activating macrophage alveolar.Th macrophage alveolar will stimulate the response of CD4+ T lymphocyte to produce IFN- γ during the active state of pulmonary tuberculosis [17]. Micro nutrients (e.g.: Zn) and vitamins such as vitamin A contained in albumin capsules are able to stimulate Th1 cell in producing IFN- γ among pulmonary TB childs patients [18]. This finding is supported by [19] who stated that Vitamin A and Zn significantly magnify the effect of tuberculosis regimen after the second week of treatment period and also accelerate the time AFB sputum conversion. Similar finding was observed in a study conducted by [20]. This study showed that Zn and Vitamin D affecting the immune level of pulmonary TB patients. Moreover, administering vitamin A, B complex, C, E and selenium at a dose of 6-10 daily in a month leads to an increase in CD4+ cytokine and a decrease in having the potential risk of extra pulmonary TB[21]. Another Catfish-protein experimental study by [22]conducted at BBPKM of Makassar shows that consuming Catfish-albumin capsules for 60 days may accelerate the conversion of BTA sputum in pulmonary TB patients.

New pulmonary TB patients receiving MDT-DOTS treatment combined with VCO supplement may accelerate the time needed for AFB sputum conversion.This possibly occurs since VCO has contained amazing long-chain saturated fatty acid i.e. Glycerol Monolaurat which acts as a potent bactericide for pulmonary TB which is in turn prohibiting the replication and reproduction of Mycobacterium TB [23]. Investigated the role Mycobacterium TB in vitro. By adding Monolaurat glycerol into study setting, the researchers then observed that the bacteria were able to morphologically

modify their structure in such ways to prohibit cell division [13]. It has also been proven that VCO supplement can amplify potential bactericidal effect of Mycobacterium TB [24]. Finally, another study by [25] found similar findings with previous VCO studies. He concluded that VCO has a capacity to improve the activity of body hormone and to actively increase receptor sensitivity in facilitating the action of Th1 and Th2 in producing IFN- γ . It has been reported in one animal experimental study that VCO supplementation in rats can increase the number of lymphocytes due to leukocyte differentiation to normalize the level of basophil and neutrophil [26].

4.2 Improvement of nutritional state

It has been believed that Catfish-albumin capsules can increase body mass index which is more likely to alter the nutritional state afterwards. This effect is caused by the action of several essential amino acids, vitamins and minerals found in it. Administering the extraction of catfish protein to the pulmonary TB patients has shown a beneficial effect on increasing the albumin level up to 0.6 grams followed by gaining in body weight as well as an increase in the intake of energy, protein, carbohydrate and fibres [12]. The essential amino acids especially lysine, methionine, glycine and arginine can increase patient's appetite and act as an additional source of body fat, mineral salt, vitamins and UGF (Uncharacterized Growth Factors). Another Catfish experimental study, which also used Catfish-extracted albumin, demonstrated that consuming this supplement may have several effects on altering disorder in patients with HIV-AIDS. These are including improving serum albumin level of patients with HIV-AIDS, increasing the whole energy intake, altering food appetite, improving nutritional state and increasing lean body mass [27].

The new pulmonary TB patients who received MDT-DOTS+VCO treatment have shown a significant improvement on their nutritional states. One possible underlying mechanism for this improvement is linked to some positive effects of Monolaurat glycerol found in VCO. Monolaurat glycerol contained in VCO downgrades protein catabolism and is acting as protein deposit which is in turn inhibiting the oxidative process of amino acids providing more energy and protein for body muscles. This protein in turn facilitates the secretion of glucagon subsequently activates adenylate cyclase to finally produce cAMP. With the presence of cAMP, the phosphorylation phase of cell metabolism will be normally activated for regulating targeted-gland secretion and enzymatic as well as hormonal activities [28]. According to [29] VCO can stimulate nutritional absorption in such a way to help treating both malnutrition and mal-absorption syndrome. Furthermore, VCO improves the absorption of water-soluble

vitamins, minerals and protein influencing the time healing and nutritional state of the patients. Another benefit of VCO to be mentioned is that it can help the patients to quickly regain their body weight by increasing energy turnover [23, 30]. Finally another VCO study by [15] which investigated the effect of octanoic acid contained in VCO mentioned that octanoic acid of VCO has similar benefit as stated in previous study; therefore it is concluded that this supplement can be used to treat pulmonary TB patients with severe malnutrition.

4.3 Improvement of chest X-ray

MDT-DOTS combined with albumin capsules can be effective on treating pulmonary TB patients as indicated by significant improvement in their chest X-ray imaging. During active pulmonary inflammation process, an increasing in number of ROS and reactive nitrogen intermediate (RIN) substance due to the rising level of oxidative stress subsequently causes a decreasing in antioxidant level significantly. This situation will finally alter the response of immune system and becomes a good indicator towards drug intoxication [31]. Similar findings are also found in several ROS-associated with pulmonary TB studies [32, 33, 34, 35].

This study concludes that antioxidants (micronutrients) supplementation as an adjuvant therapy helps in reduction of oxidative stress and promotes recovery of patients [36]. Since pulmonary TB has been commonly linked to poor nutritional state a way which may exaggerate the increasing level of ROS substance [32] and representing the severity level of diseases, therefore providing a proper anti oxidative adjuvant therapy such as Catfish albumin capsules becomes an advisable option [33]. As it is mentioned in Reddy, albumin protein is able to boost the amount of antioxidant in the targeted cell, accelerating the healing process and inhibiting pulmonary tissue damaging due to Mycobacterium TB activated ROS-associated inflammation process. Moreover, albumin protein is plasma's major component which has a capacity to bind either the divalent cation of free fatty acid molecules or hydrochloride hydrogen [37].

To sum up, based on all the facts mentioned previously, pulmonary TB patients receiving MDT-DOTS combined with VCO supplement have shown a significant improvement on their chest X-ray imaging. This is due to the anti oxidative effect of VCO in increasing the level of antioxidant [38, 39, 14].

IV. CONCLUSION

From this experimental research and supported by the existing literatures, the following conclusions can be made:

1. Consumption of albumin capsules (Catfish protein) accelerated the conversion of BTA sputum, increased nutritional state and improved chest X-ray imaging in pulmonary TB.
2. Consumption of Virgin Coconut Oil (VCO) accelerated the conversion of BTA sputum, increased nutritional state and improved chest X-ray imaging in pulmonary TB.
3. Consumption of albumin capsules (Catfish protein) combined with VCO accelerated the conversion of BTA sputum, increased nutritional state and improved chest X-ray imaging in pulmonary TB.
4. The experimental groups that received Catfish extracted-albumin combined with VCO demonstrated better accelerating in the conversion of BTA sputum, increasing in nutritional state and improving on chest X-ray imaging in pulmonary TB compare to those in control placebo group.
5. The experimental group that received only Catfish extracted-albumin compared to VCO group demonstrated better accelerating in the conversion of BTA sputum, increasing in nutritional state and improving on chest X-ray imaging in pulmonary TB.

REFERENCES

1. WHO: "Global Tuberculosis Report Control Surveillance, Planning and Financing", Geneva, World Health Organization.2012.p:9-24
2. Kemenkes RI:Pedoman Nasional Pelayanan Kedokteran Tatalaksana Tuberkulosis.Jakarta.2013
3. Timothy, *et al*: *Time to Sputum Culture Conversion in Multidrug-Resistant Tuberculosis: Predictors and Relationship to Treatment Results* "From the Center for Disease Control and Prevention, Atlanta, Georgia, and the State Agency for Tuberculosis and Lung Diseases, Riga, Latvia. 2006.
4. Khariroh., Syamilatul: *Factor Risiko Kegagalan Konversi Pasien Tuberkulosis Paru Program Pengobatan DOTS FaseIntensif DiRumah Sakit DR SOETOMO Dan Pencegahan Penyakit Dan Badan Pengendalian (BP4) Karang Tembok Surabaya*.Program Pasca Sarjana Universitas Airlangga. 2006.
5. Guler.,*et.*, al.,2007.*Factors influencing sputum smear and culture conversion time among patients with new cases of pulmonary tuberculosis*. International Journal of Clinical Practice, Volume: 61, : 231-235.
6. Subowo.2010. "Imunologi Klinik".CV Sagung Seto.Edisi 2.PO.Box 4661 /Jakarta 10001. Email: admsagung@sagung.co.id.
7. Subagyo, A., Aditama, T.Y., Sutoyo, D.K., Partakusuma, L.G: *Pemeriksaan Interferon Gamma Dalam Darah Deteksi Infeksi Tuberkulosis*. Jurnal Tuberkulosis Indonesia.Vol 3.No 2.2006.pp 6-19
8. Ahmad, S: "Review Article Pathogenesis, Immunology, and Diagnosis of Latent Mycobacterium tuberculosis Infection".Clinical and Developmental Immunology Volume 2011 (2011), Article ID 814943, 17 pages doi:10.1155/2011/814943.Department of Microbiology, Faculty of Medicine, Kuwait University, P.O. Box 24923, 2011.Safat 1311
9. Khariroh., Syamilatul, 2006. *Factor Risiko Kegagalan Konversi Pasien Tuberkulosis Paru Program Pengobatan DOTS FaseIntensif DiRumah Sakit DR SOETOMO Dan Pencegahan Penyakit Dan Badan Pengendalian (BP4) Karang Tembok Surabaya*.Program Pasca Sarjana Universitas Airlangga.2006
10. Rumende, C.M., Sukmana, N., Suwondo, Amin, Z., Sibuea, W.H."Hubungan antara derajat lesi Tuberkulosis Paru dengan Status Imunitas Selluler pada Pasien Tuberkulosis".Subbagian Pulmonologi Bagian Ilmu Penyakit Dalam FKUI/RSUPN Dr.Cipto Mangunkusumo Jakarta.Acta Medica Indonesia.Volume XXXII,No.3.2000:103-106.
11. Muller H., Kruger S:Immunohistochemical analysis of cell composition and in situ cytokine expression in HIV and non-HIV -associated tuberculous lymphadenitis. Immunobiology ;1994.191:354-368
12. Taslim, NA et al:"Pembuatan Tepung Ikan Gabus Sebagai Makanan Tambahan Sumber Albumin Dan Pemanfaatannya". Pusat Penelitian Pangan, Gizi Dan Kesehatan. Universitas HasanuddinMakassar.2005.
13. Rotor, AV:*Glycerol Monolaurat (GML) in Virgin Coconut Oil Destroys Tuberculosis Bacteria*. Multi Disciplinary Research Journal of the UST Graduate School.Volume 8.Number 1.Manila Filipina.2008
14. Zakaria, A., Somchit, M.N., Mat.J:*In vivo antinoceptive and anti inflammatory activities of dried and fermented processed virgin cocnut oil*.Med Princ Pract;20(3).2011:231-6
15. Ashitani, J.I., Matsumoto.N, Nakazato.M:*Effect of octanoid acid-rich formula on plasma ghrelin level in cachectic patients with chronic respiratory disease*.Licensee BioMed Central Ltd.Japan.2009
16. Green, A.M., Robert DiFazio, R., Flynn, J.L:IFN- γ from CD4 T Cells Is Essential for Host Survival and Enhances CD8 T Cell Function during Mycobacterium tuberculosis Infection. The Journal of Immunology.2000
17. Schwander SK, Torres M, Sada E, et al. Enhanced responses to Mycobacterium tuberculosis antigens by human alveolar lymphocytes during active pulmonary tuberculosis. J Infect Dis 1998;178:1434-45.

18. Hanekom, W.A., Hussey, G.D., Hughes, E.J., Potgieter, S., Yogeve R., Check .I.J.1999. Plasma soluble CD30 in childhood tuberculosis: effects of disease severity, nutritional status and vitamin A therapy. *Clin Diagn Lab Immunol*;6:204-8
19. Karyadi E., West CE., Schultink W., Nelwan RH., Gross R., Amin Z., Dolmans WM., Schlebusch H., van der Meer JW.2002. A double-blind, placebo-controlled study of vitamin A and zinc supplementation in persons with tuberculosis in Indonesia: effects on clinical response and nutritional status. *Am J Clin Nutr*;75(4):720-7
20. McMurray DN., Bartow R.A., Mintzer C.L., Hernandez-Frontera E.1990. Micronutrient status and immune function in tuberculosis. *Ann N Y Acad Sci*;587:59-69
21. Diekema, D.J., Villamor E et al. 2008. Nutritional Supplementation and TB Treatment. *Journal Infect Dis*. 1
22. Malle.J. 2008. "Pengaruh Pemberian Kapsul Tepung Ikan Gabus Terhadap Status Gizi dan Proses Penyembuhan Penderita Tuberkulosis paru di Balai Besar Kesehatan Paru Masyarakat Makassar". Tesis. Program Pascasarjana UNHAS
23. Fife, Bruce, C.N., N.D, 2004. Coconut Oil Miracle, Cetakan kedua, PT Bhuana Ilmu Populer, Jakarta 1114
24. Dalmacion, J.2011. "Infectious Disease Natural-grown Killers VCO for Tuberculosis". International peer-reviewed Journal; pp 57-60
25. Endaryanto, A., Harsono, 1990, "The of probiotics in allergy prevention through the active induction of immunological tolerance". Faculty of Medicine Airlangga University/RSUP Dr Sutomo Surabaya Indonesia
26. Handajani, N.S., Dharmawan, R. 2009. "Effect of VCO to leucocyte differential count, glucose levels and blood creatinine of hyperglycemic and ovalbumin sensitized *Mus musculus Balb/c*". Department of Biology, Faculty of Mathematic and Natural Sciences, Sebelas Maret University. Nusantara BIOSCIENCE, Central Java Indonesia. Vol. 1, No. 1, Pp. 1-8
27. Ashari, N. 2011. "Pengaruh Pemberian Ekstrak Ikan Gabus Terhadap Peningkatan Imunitas Penderita HIV/AIDS". Thesis Pasca Sarjana Universitas Hasanuddin Makassar
28. Guyton, A., Hall, J.E. 2008. "Textbook of medical physiology". 11st ed. Elsevier. New York
29. Enig MG, 2012. Coconut: In Support of Good Health in the 21st Century. The web site was jointly developed by the USDA Nutrient Data Laboratory, and the Food and Nutrition Information Center and Information Systems Division of the National Agricultural Library
30. American Society for Microbiology. 2011. *Benefit of Virgin Coconut Oil*. Nutiva is USDA Certified Organic. visit: <http://intl-journals.asm.org>
31. Walubo A., Smith PJ, Folb PI. 1995. "Oxidative stress during antituberculosis therapy in young and elderly patients. *Biomed Environ Sci* 1995; 8 : 106-110
32. Jolly, C.A. 2004. *Dietary Restriction and Immune Function*. Division of Nutritional Sciences, The University of Texas Austin. American Society for Nutritional Sciences; pp 1853-1856
33. Reddy, Y.N., Murthy, S.V., Krishna, D.R, and MC Prabhakar. 2004. "Role of Free Radicals And Antioxidants in Tuberculosis Patients". *Indian J. Tuberc*. 51:213-218
34. Kaur, K., Jai, K., Gurdeep, K.B, and Rajinderjit, S.A. 2005. "Oxidants Stress And Antioxidant in Pulmonary Tuberculosis". diakses tanggal 30 Juli 2011
35. Mohod, K., Archana, D, and Smith, K. 2011. "Status of Oxidants and Antioxidants in Pulmonary Tuberculosis With Varying Bacillary Load". *Journal of Experimental Science*. 2(6):35-37
36. Pawar, BD., Suryakar, AN., Khandelwal, AS: "Effect of micronutrients supplementation on oxidative stress and antioxidant status in pulmonary tuberculosis". Registrar, Maharashtra University of Health Sciences, Nashik, Maharashtra, India. *Biomedical Research* 2011; 22 (4): 455-459
37. Narwadiya, S.C., Dhumne, U.L., Sahare, K.N., Tumane, P.M., Meshram, V.G., Singh, V. 2012. "Serum Protein Level Changes in Dots Administered Patients of Nagpur District: A Case Study". P.G. Department of Microbiology, R. T M Nagpur University, Nagpur - 440 033, Maharashtra, India 2 National Institute of Miner's Health, Nagpur - 440 023, Maharashtra, India. *ASIAN J EXP. BIOL. SCI. VOL* 3(1); 251-254
38. Loliger, J. 1991. "In Free Radical and Food Additives". Disunting oleh O.I. Aruoma and B. Halliwell. London: Taylor and Francis
39. Gerster H: Can adults adequately convert alpha-linolenic acid (18:3n-3) to eicosapentaenoic acid (20:5n-3) and docosahexaenoic acid (22:6n-3)? *International Journal of Vitamin and Nutrition Research* 1998;68:159-173

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