Integrated pest and disease management of coconut in heavily root (wilt) disease affected districts of Kerala state - a success story

R. Chandra Mohanan

Principal Scientist & Acting Head, Division of Crop Protection, Central Plantation Crops Research Institute, Kasaragod, Kerala

Coconut cultivation in heavily root (wilt) affected areas is profitable if the farmer adopt the recommended scientific technologies.

High incidence of root (wilt) and leaf rot diseases

Introduction

Integrated pest and disease management technologies involving various control methods like mechanical, sanitation, chemical/ biological control etc. have been developed for the management of coconut pests and diseases. Among the pests of coconut, eriophyid mite, red palm weevil and rhinoceros beetle have been recognized as the major pests in heavily root (wilt) disease (RWD) affected tracts of Kerala viz., Ernakulam, Kottayam, Pathanamthitta, Alappuzha and Kollam. Effective pest management practices have been evolved to combat these major pests.

In the heavily RWD affected districts, yield of the palms can be sustained or improved considerably by adopting proper crop management practices. Since there are no curative or prophylactic measures available, greater importance is given to leaf rot control in RWD affected palms. Leaf rot disfigures the RWD affected palms giving them a sick appearance. Usually, it is only at this stage the farmers recognize that the palms are diseased and they have neglected the palms as RWD affected palms. As the leaf area is very much reduced due to extensive rotting, there is drastic reduction in yield. The rotting smell also invites red palm weevil the most serious pest of coconut in the leaf rot affected areas. By the effective management of leaf rot and major pests, the yield of the palms in the heavily RWD affected areas can be improved substantialy.

Integrated pest and disease management in heavily root (wilt) disease affected areas in Kerala State

A project under Technology Mission On Coconut (TMOC) has been implemented in five heavily RWD affected districts of Kerala State to practically demonstrate the advantages of scientific cultivation practices for coconut as well as to educate the farmers on different aspects of crop management with special emphasis on integrated pest and disease management. The economically viable technologies developed for increasing the income per unit area by improving the health and yield of palms were convincingly demonstrated during

A project entitled "Integrated pest and disease management of coconut in heavily root (wilt) disease affected districts of Kerala State to develop model coconut farms'" was sanctioned to the Central Plantation Crops Research Institute(CPCRI), Regional Station, Kayamkulam during the year 2004-05 by the Coconut Development Board under the Technology Mission on Coconut for a period of three years. The total project cost was Rs.20 lakh with 100% financial assistance from the Board.

The major objective of the programme were to demonstrate recommended integrated pest and disease management technologies focusing more on economic management of root (wilt) disease and major pests in heavily root(wilt) disease affected districts to get considerable increase in yield, to create awareness in implementing the economically viable technologies for getting sustainable yield and to train farmers on different aspects of crop management. The project was implemented in 5 ha contiguous area in the five heavily RWD affected districts viz., Chavara (Kollam Dist.), Adoor (Pathanamthitta Dist.), Kumarapuram (Alappuzha Dist.), Thirumarady (Ernakulam Dist.) and Changanacherry (Kottayam Dist.)

The demonstration programme has improved the average yield of palms to 36 nuts per palm/year from 15 nuts per palm/year before the implementation of the programme, reduction in intensity of root wilt disease, especially in the disease advanced category to 2.6% from 12.7% before implementation and significant reduction in major pests and diseases-leaf rot, rhinoceros beetle, eriophyid mite, red palm weevil, coreid bug, stem bleeding etc. After 3 years of implementation of the programme, the net income/palm/year was found to be Rs.60.45/- compared to Rs.0.11/- in control plots.

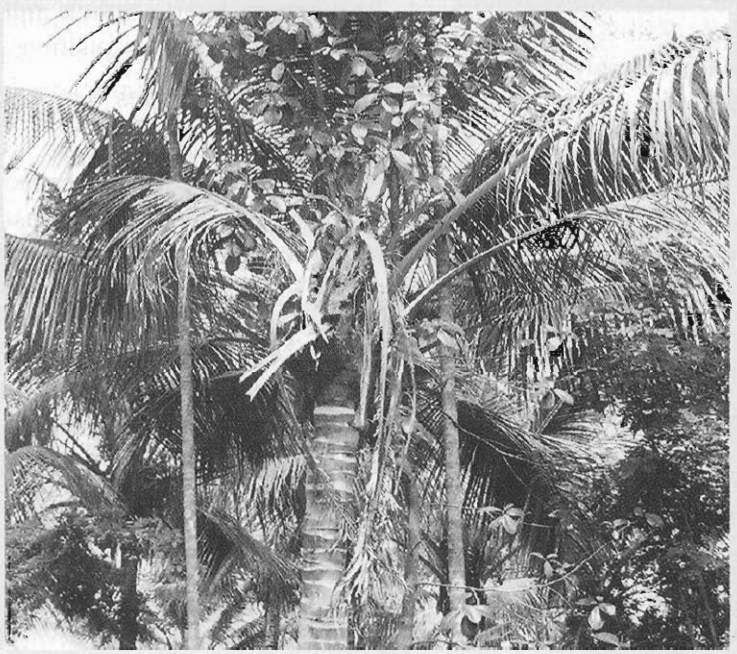
2005-07 by implementing the technologies in 5 ha contiguous area in each of the five heavily RWD affected districts viz., Kollam, Pathanamthitta, Alappuzha, Kottayam and Ernakulam. Regular training programmes and practical demonstrations on various aspects of coconut cultivation including pest and disease management practices were organized during the three year period. The details of the status of coconut gardens before implementing the recommended technologies (1st year – 2005), during technology implementation and demonstration (2nd year – 2006) and after the demonstration (3rd year – 2007) in 5 ha contiguous area in each district are presented in brief to highlight the success of scientific cultivation practices.

Selection of locations for implementing the technologies:

Random surveys were conducted in different Panchayaths in the five districts for selection in locations for implementing the scientific cultivation practices.

Selection of locations and coconut gardens were based on the following criteria:

a) Heavy incidence of pests and diseases
b) Poor knowledge and adoption of



Red palm weevil infestation

Rhinoceros beetle - a serious pest in all locations of project area

technologies for crop management

c) Such programmes were not implemented earlier in the area

d) Suitable location for a model farm in the district

Based on the above criteria Chavara (Kollam Dist.), Adoor (Pathanamthitta Dist.), Kumarapuram (Alappuzha Dist.) and Changanacherry (Kottayam Dist.) were selected as the locations for implementing the project.

(89.3%) followed by Thirumarady in Ernakulam district (82.9%). RWD incidence at Kumarapuram (Alappuzha dist.), Changanacherry (Kottayam dist) and Chavara (Kollam dist) was 71.7, 72.1 and 68.1% respectively. Leaf rot disease (infection in the spindle leaf) was the highest at Thirumarady (27.9% of palms). Percentage incidence of leaf rot disease affected palms at Chavara, Changanacherry and Adoor did not vary much. Among the pests, Eriophyid mite and Rhinoceros beetle

of Changanacherry-22, Chavara-15, Kumarapuram-14, Thirumarady-14 and Adoor-11. The average yield of all 5 locations was 15 nuts/palm/year. Thus yield was found to be very poor (Table 3).

Reasons for poor yield before the implementation of technologies:

1. Thick overhead shade due to other trees in the plot.
2. Red palm weevil infestation and retention of dead palms in the field.

Table 1. Incidence of major pests and diseases in the project area during 2005-2007

Districts/Location	% of affected palms											
	RWD			RWD + LRD			Mite			RB		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
Kollam(Chavara)	68.1	72.21	72.23	15.7	7.93	4.47	11.0	4.57	5.8	10.2	2.8	0.7
Pathanamthitta(Adoor)	89.3	89.26	91.4	14.6	3.41	7.07	53.0	49.1	15.3	68.8	9.26	1.51
Alappuzha (Kumarapuram)	71.7	73.44	74.6	19.6	11.25	6.6	71.9	10.1	10.24	21.1	6.06	0.88
Kottayam (Changanasserry)	72.1	74.67	82.12	15.7	8.34	4.8	34.1	3.1	2.65	22.6	4.02	0.87
Ernakulam (Thirumarady)	82.9	84.6	84.4	27.9	6.8	4.1	54.1	4.3	4.2	26.1	4.9	2.2
Total	**73.97**	**76.26**	**78.94**	**18.4**	**8.46**	**5.4**	**42.9**	**7.1**	**7.1**	**23.81**	**4.9**	**1.08**

RWD – Root (wilt) disease LRD - Leaf Rot Disease RB - Rhinoceros Beetle

Status of coconut gardens before implementing the project (pre-demonstration period – 2005):

Thick overhead shade caused by other trees in the coconut garden was a major problem in all the five locations. This has been found to be one of the main reasons for the poor yield in all the locations. Palms in the very advanced stage of root (wilt) disease, senile uneconomic palms and palms dead due to pests and diseases were existing in the field.

Incidence of pests and diseases (2005):

Pest and disease incidence and yield of individual palm was recorded before implementing the technologies. The incidence of root (wilt) disease was the highest at Adoor, in Pathanamthitta district

were found to be the major problems in all the five locations. Eriophyid mite infestation was the highest at Kumarapuram (71.9% of palms) followed by Thirumarady (54.1%). But Rhinoceros attack was the highest at Adoor (68.8% of palms) followed by Thirumarady (26.1%) (Table 1).

Boron deficiency symptoms were recorded in 61 palms in 5 locations. Altogether 22 palms were only affected by Red palm weevil in the 5 locations. Stem bleeding disease was noticed in 5 palms in the project area in 5 locations.

Yield of coconut palms before implementing recommended technologies

The coconut yield was very low in all locations and the average yield of nuts/palm/year was in the order

3. Severe incidence of leaf rot disease.
4. Rhinoceros beetle attack and completely neglected condtion.
5. Fertilizer and manures were not applied.
6. Non-adoption of recommended management practices against major pests and diseases.
7. Rainfed nature of palms.
8. Farmers were not aware of many of the recommended technologies.

Pest and disease incidence during 2nd year of project implementation (2006):

The incidence of root (wilt) disease was the highest in Adoor in Pathanamthitta district (89.3% in

Table 2. Intensity of RWD in project area of five districts from 2005-2007

Districts/Location	% of RWD affected palms including seedlings											
	Root (wilt) disease									RWD affected palms		
	DE			DM			DA					
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
Kollam(Chavara)	6.9	13.98	33.2	35.2	49.33	37.4	25.9	8.88	1.5	68.1	72.21	72.23
Pathanamthitta(Adoor)	23.9	38.5	42.42	56.1	45.8	45.0	9.3	4.8	4.0	89.3	89.26	91.4
Alappuzha (Kumarapuram)	5.6	33	33.3	53.4	35.3	38.4	12.7	5	2.9	71.7	73.44	74.6
Kottayam (Changanasserry)	5.3	18.70	24.4	61.2	53.2	54.2	5.6	2.7	3.49	72.1	74.67	82.12
Ernakulam (Thirumarady)	13.0	21.4	49.52	61.2	59.3	34.0	8.7	3.4	0.95	82.9	84.16	84.4
Total	**8.35**	**23.8**	**33.61**	**52.9**	**47.5**	**42.7**	**12.73**	**4.99**	**2.63**	**74**	**76.27**	**78.94**

RWD – root (wilt) disease, DE- disease early, DM – disease middle, DA – disease advanced
2005 -Pre demonstration
2006 -During demonstration
2007 -Post demonstration

2005 and 89.26% in 2006) followed by Thirumarady in Ernakulam district (82.9% in 2005 and 84.6% in 2006). Though RWD incidence did not vary much between 2005 (before implementing technologies) and 2006, the palms in the advanced stage of RWD during 2006 was less than that of 2005 in all five locations. This can be attributed to the effect of management practices for RWD, especially leaf rot disease management and nutrient management. Leaf rot disease was observed in 8.46% of palms in five locations during 2006 whereas it was 18.4% during 2005.

The overall incidences of mite attack in project area in 5 districts were 42.9% in 2005 and 7.11% in 2006. The incidence of rhinoceros beetle attack was observed only in 4.9% of the palms in the five locations during 2006. It was 23.81% before the implementation of the integrated management practices. Rhinoceros beetle attack was the highest in Adoor (68.8% palms), Pathanamthitta district followed by Thirumarady, Ernakulam district (26.1%) in 2005.

Integrated management of leaf rot disease of coconut

After adopting the management practices the pest incidence was only 9.26% in Adoor and 4.9% in Thirumarady respectively during 2006. The incidence of rhinoceros beetle attack in other locations was

Table 3. Estimated yield of coconut palms in project area of five districts during 2005-2007

District	Mean yield (No. of nuts/palm/year) (Mean of each location)		
	2005	2006	2007
Kollam (Chavara)	15	19.4	33
Pathanamthitta (Adoor)	11	17.0	29
Alappuzha (Kumarapuram)	14	21.0	39
Kottayam (Changanacherry)	22	33.1	43
Ernakulam (Thirumarady)	14	23.6	38
Mean of five locations	**15**	**22.8**	**36**

2005 – pre-demonstration 2006 – during demonstration 2007 – post demonstration

also less during 2006 (Table 1). A total of 25 palms only were found to be affected by red palm weevil in the five locations. Rare incidence of stem bleeding disease was also noticed only in these districts.

There was significant reduction in the incidence of major pest attack after adopting the integrated management practices in all the locations except in the case of eriophyid mite infestation at Adoor (Pathanamthitta district). Therefore all the palms in the selected plots at Adoor were treated with azadirachtin (0.004%) before and after the south-west monsoon in 2006. Recommended management practices for all pests and diseases were carried out.

Yield of coconut palms during 2006

The coconut yield was very low in all locations before starting the project (2005). Yield of coconut palms in all five locations increased during 2006 after implementing the recommended management practices (average yield-nuts/palm/year: Chavara 19, Adoor 17, Kumarapuram 21, Changanacherry 33, Thirumarady 23) The average yield of all 5 locations was 22.8 nuts/palm/year during 2006 (*Table 3*).

Pest and disease incidence during the 3rd year of project implementation (2007):

The incidence of root (wilt) disease was the highest in Adoor, Pathanamthitta district (91.4%) followed by Thirumarady, Ernakulam district (84.4%) in 2007. The palms in the advanced stage of RWD during 2007 was less than that of 2005 in all the five locations (Table 2). Leaf rot disease was observed in 5.4% of palms in five locations during 2007 whereas it was 18.4% during 2005. Eriophyid mite incidence was noticed only in 7.1% of the palms in 2007 whereas it was found in 42.9% of the palms before starting the Project.

The incidence of rhinoceros beetle attack was observed only in 1.08% of the palms in the five locations during 2007. It was 23.81% before the implementation of the integrated management practices. The incidence of rhinoceros beetle attack in other locations was also less than 1%. Red weevil infestation was noticed only in 26 palms in the TMOC project area in five locations during this year.

Yield of coconut in 2007

The coconut yield was very low in all locations before starting the project (2005). Yield of coconut palms in all five locations increased after implementing the recommended management practices (average yield during 2007-nuts/palm/year: Chavara 33, Adoor 29, Kumarapuram 39, Changanacherry 43 and Thirumarady 38) (Table 3).

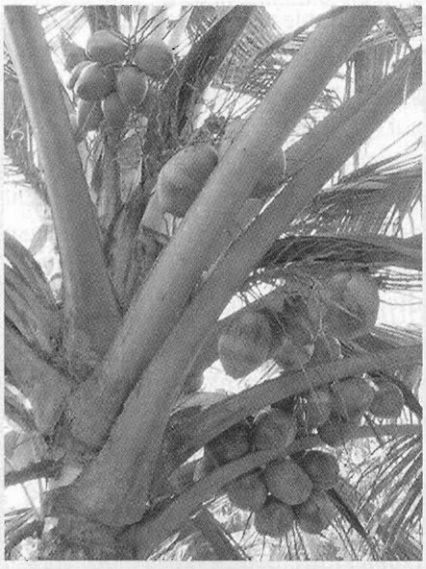
Nutrient management

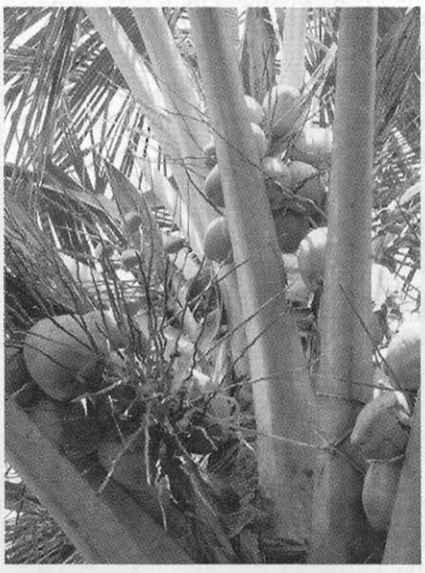
As nutrient management is an important factor in the integrated management of pests and diseases, recommended nutrient management practices were adopted in all five locations. Thick overhead shade which was found to be one of the major causes of poor yield of

Table 4. Cost of inputs and operational charges for management of one coconut palm per year (based on average of all the palms in project area of five Districts)

Particulars	Amount (Rs.) spent/palm/year		
	2005	2006	2007
Cost of fertilizers	27	25	25
Cost of green manure seeds	3	3	3
Application charges of fertilizers and manures	20	20	20
Cost of pesticides	2.26	1.05	0.15
Application charges of pesticides	7.49	3.20	0.95
Cost of harvest	36	36	36
Total	95.75	88.25	85.1

Cost (Rs. 25/-) of organic manure (green leaf) is not included as it was taken from the respective plots (removing overhead shade and restructuring the garden)





Eriophyid mite management -bunches free from mite infestation after treatment

coconut palms in all 5 locations was removed and green leaves were applied to coconut basins as green manure during the application of second dose of fertilizer. The advantages of growing green manure crop (cow pea) during April-May (after applying the first dose of fertilizer) in coconut basins of 1.8 m radius and incorporating it into the soil during October (at the time of second dose of fertilizer application) were also demonstrated.

Training programmes, farmers meetings and field demonstrations

Group meetings and training programmes were organized in all five districts. Field demonstrations on integrated management practices for the control of leaf rot disease, stem bleeding diseases, red palm weevil, eriophyid mite and rhinoceros beetle were organized in all locations. Selected farmers in each location were given intensive training on different aspects of cultivation practices. A small note containing important aspects of coconut cultivation including pest and disease management practices was prepared and given to each farmer in the project area as a ready reckoner.

Mobile coconut clinic

Mobile coconut clinic was operated in and around the project area and demonstrated the management practices for the control of coconut pests and diseases.

The major activities undertaken through mobile coconut clinic were:

a) Demonstration of root feeding techniques of fungicide/ insecticide

b) Leaf rot management

c) Integrated management of red weevil and rhinoceros beetle attack and stem bleeding disease.

d) Control of immature nut fall.

Impact of the technologies implemented

Control of pests and diseases:

The data indicates that all the major pests and diseases could be controlled to the economic level by adopting the recommended management practices. Nutrient management is also important in maintaining the health and vigour of the palm. Leaf rot disease was observed in 18.4 % of the palms in the five districts before implementing the management

Table 5. District-wise cost of production and yield per palm per year after implementing the technologies (3rd year)

District	Project area			Control plot (farmers practice)		
	Cost of inputs and operational charges (Rs.)	Average yield (No. of nuts/ palm/year)	Cost of nuts (Rs.)	Cost of inputs and operational charges (Rs.)	Adopting yield (No. of nuts/ palm/year)	Cost of nuts (Rs.)
Kollam (Chavara)	85.24	32.54	130.16	45.75	11.00	44.00
Pathanamthitta (Adoor)	85.75	28.68	114.72	30.00	8.20	32.80
Alappuzha (Kumarapuram)	84.95	39.17	156.68	42.32	10.2	40.8
Kottayam (Changanacherry)	84.70	43.07	172.28	45.25	12.11	48.44
Ernakulam (Thirumarady)	84.85	38.49	153.96	38.51	9.31	37.24
Average of 5 districts	85.11	36.39	145.56	40.57	10.17	40.66
BC Ratio			1.71			1.0

*Cost/nut = Rs. 4

practices. During the demonstration period (2006) leaf rot disease was observed only in 8.46 % of the palms. During the third year of technology adoption this disease was noticed only in 5.4 % of the palms in the project area of five districts. Rhinoceros beetle attack was a major problem in all the districts before the implementation of technologies. Though 23.8 % of the palms were affected by this pest before adopting management practices the pest attack was very much reduced during the 3rd year (2007) with only 1.08 % of the palms with rhinoceros beetle attack.

Eriophyid mite infestation was also a major problem in all the coconut garden in the project area in five districts. Mite attack was observed in 42.9 % of the palms in 2005 (before demonstration). But only 7.1% of the palms were showing mite attack during the 3rd year of technology adoption.

Sporadic incidences of red palm weevil, coried bug, rat damage, stem bleeding disease and immature nut fall caused by *Lasiodiplodia theobromae* also could be controlled.

Effect of integrated management practices on the reduction in intensity of root (wilt) disease:

Though there was not much difference in the number of palms affected by RWD during the pre and post demonstration period, there was considerable reduction in the intensity of the disease. The RWD affected palms were categorized as disease early, disease middle and disease advanced on the basis of disease index. The impact of the management practices in reducing the disease intensity, especially intensity of disease advanced stage is clearly visible. The percentage of palms in the disease advanced category (disease intensity score > 50) was reduced remarkably to 2.6 % from 12.7 % after technology adoption (Table 2). These observations emphasize the feasibility of the technologies in bridging the yield gap due to the disease.

Improvement in the yield of palms

The adoption of integrated pest and disease management practices and nutrient management was effective in improving the average yield of palms in the farmers fields in the heavily root (wilt) disease affected areas. Since the management practices help in

Integrated Pest and Disease Management -Practical field demonstrations

regaining the health, it will also be reflected in the yield.

The coconut yield was very low in all locations before starting the project. The yield has increased considerably during the third year of project implementation. The average yields of coconut in five locations before demonstration (2005) during demonstration (2006) and after demonstration (2007) were 15, 23 and 36 nuts/palm/year respectively (Table 3). The yield of palms will definitely increase further in the coming years and hence there will be remarkable increase in productivity.

Cost of inputs and operational charges for management of coconut palms in project area of five districts

Details of cost of inputs and labour charges for the management of coconut palms in the five locations of project area are presented in Tables 4 & 5. The labour charges were higher than the cost of critical inputs. Out of different items of labour charges the cost involved in harvesting the nuts was the highest. The total cost of inputs and operational charges per palm (average of five locations) during 1st year (2005), 2nd year (2006) and 3rd year (2007) of Project implementation were Rs.95.75, 88.25 and 85.1 respectively (Table 4). Cost of green leaf applied along with 2nd dose of fertilizer was not included as it was taken from the respective plots by removing the overhead shade. But application charges were included.

The cost of inputs and operational charges spent by the farmers in control plots varied from Rs. 30 to 46 (Table 5). The main expenditure was for the harvesting of nuts.

Cost of production

The cost of inputs and operational charges for the management of one coconut palm per year during the third year of demonstration (2007) varied from Rs. 84.70 to Rs. 85.75 between the districts. The average cost of inputs and operational charges (per palm per year) of the five districts was Rs. 85.11 and the average yield (no. of nuts/palm/year) was 36.39 nuts. Thus the cost of nuts (@ Rs. 4/- per nut) obtained from one palm per year was calculated as Rs. 145.56. Therefore the net income from one palm per year (2007) was found to be Rs. 60.45. On the other hand, the average (of 5 districts) cost of inputs and operational charges spent by the farmer in the control plots for the management of one palm per year was Rs. 40.57 and the average yield was only 10.17 nuts/palm/year. Thus the cost of nuts obtained from one palm/year was found to be only Rs. 40.68 (@ Rs. 4/- per nut).

The yield of coconut palms in the project area will definitely increase further if the farmers continue the scientific technologies implemented and demonstrated. The results of the investigation clearly indicate that coconut cultivation is profitable if the farmers adopt the recommended scientific technologies. Thus by adopting scientific cultivation practices, the coconut productivity can be increased.

Consumer awareness on edible oils

Coconut oil(CNO) was popular in India for times immemorial, as it was locally available and consumed along with Gingelly Oil(Sesame Oil) and mustard seeds rich in essential fatty acids, which are absent in CNO. It was pointed out that CNO is high in saturated in fatty triglycerides and bad for the heart and consumers switched over to other oils like palmolein, costing less compared to the CNO cost. The research findings of UNIV of Kerala and abroad has concluded that CNO is the healthiest oil on earth by an American doctor Bruce Fife and if used daily for cooking purposes could help to protect users from heart disease, cancer and other degenerative conditions, improve digestion, strengthen immune system and even helps one to loose excess weight. (Ref. *The Healing Miracles of Coconut Oil* by Dr. Brufe Fife) . Clinical studies have shown that CNO has anti microbial and anti viral properties and it is used to treat AIDS. The high saturated fatty acids content in CNO consists of medium chain fatty glycerides in abundance and is responsible for its health benefits. There is demand for virgin CNO as the same in capsule are consumed in USA for its health benefits. Even if one consumes 10-15 gms of fresh coconut kernel in any form instead of coconut chutney, one can get virgin coconut oil benefits as proteins are also present in kernel which is healthy.

Source: Keemat, February 2008