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The Chemical Constituents of *Symplocus racemosa* Roxb.

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Abstract : From *Symplocus racemosa* Roxb. oleanolic acid, acetylolesnolic acid, betulinic acid and ellagic acid have been isolated.

1. Introduction

Symplocus racemosa Roxb. is a small tree or shrub belonging to the natural order Styraceae. The leaves are 5 × $1\frac{3}{4}$ ins in dimension, obtuse, coriaceous. It is found at elevations of 4,500 ft in N.E. India, Burma and China. The sample under investigation was purchased in the local market. This is also called Srimata and Tilaka because of its use in India for making the Tilaka mark on the forehead. Extracts of the bark of *S. racemosa* have been used in Ayurvedic medicine for phlegmatic diseases, leprosy, gum diseases especially bleeding gums.[1]

Earlier work on the species have indicated the presence of glycosides,[5,6] saponins,[7] and alkaloids.[8] Petroleum ether and ether extracts of *S. racemosa* afforded a high yield of betulinic acid with smaller amounts of acetyloleanolic acid and oleanolic acid. The cold methanolic extract yielded ellagic acid. The structures were arrived at from analytical data, IR, NMR and mass spectral data together with the fragmentation pattern.[2] Final confirmation was obtained by direct comparison with authentic samples.

2. Experimental

Acetyloleanolic acid. The dried shavings of the bark of *S. racemosa* (600 g) were extracted with petroleum ether (60° — 80°C) in a soxhlet apparatus during 18 hours. Evaporation of the solvent gave a solid (20 g) which was dissolved in chloroform and clarified by passing through a half inch layer of neutral alumina in a wide tube. The eluate which showed several spots in TLC was evaporated and the residue crystallised from methanol.

Recrystallisation from chloroform/petroleum ether gave colourless needles. (10g ; 1.6% of dry weight of bark) m.p. 276—78° (lit. 268°)[3] $[\alpha]^{20}_D \pm 70$ (lit. ± 70 ± 1.5)[4] ; IR 1690, 1740 cm^{-1}. The mass spectrum showed a peak at m/e 452 which is M—46 (most likely M—HCOOH) (Found : C, 76.87 ; H, 9.91% Calc. for $C_{32}H_{50}O_4$: C, 77.10 ; H, 10.04%). The NMR spectrum gave the following signals δ 5.3 (m, 1H) vinyl proton at C_{12}, 4.5 (t, 1H) C_3 proton, 2.0 (s, 3H) methyl of the acetate, 0.8 (s, 3H), 0.86 (s, 9H), 0.96 (s, 6H), 1.0 (s, 3H) 7 methyl groups. The product on hydrolysis gave oleanolic acid m.p. 308—9° (lit. 306—8°)[3] identical in all respects with an authentic specimen of oleanolic acid.

The methyl ester of the above compound was prepared by treating the compound with excess diazomethane and had a m.p. 221—23° (lit. 223).[3] The NMR spectrum gave the following signals : δ 5.3 (m, 1H) vinyl proton at C_{12}, 3.6 (s, 3H) ester methyl ; 2.02 (s, 3H) methyl of acetate. The mass spectrum showed the molecular ion m/e 514 and the fragmentation pattern was identical to that shown by Δ^{12} unsaturated oleanenes.[2]

Oleanolic acid. The mother liquor after the separation of acetyloleanolic acid and evaporation gave 3 spots on TLC corresponding to the R_F values of acetyloleanolic, oleanolic acid, betulinic acid. These were chromatographed on silica gel and progressively eluted with benzene, benzene/chloroform and chloroform. Fractions 30—33 from chloroform on evaporation gave oleanolic acid m.p. 308°—309° (lit. 306—8°)[3] undepressed on admixture with authentic oleanolic acid.

Betulinic acid : After extraction with petroleum ether, the bark was exhaustively extracted with ether during 18 hrs. The residue (18 g) which had separated on the sides of the flasks was collected, dissolved in chloroform and filtered through a thin layer of alumina (½ in). The eluate was evaporated and the residue crystallised from ether/methanol and finally from ethanol as needles m.p. 307—8° (lit. 304—21°)[3] (10g. 1.6% of dry weight of bark). The NMR spectrum contained the following signals : δ 4.6 (d, 2H) J = 3Hz vinyl protons, 1.62 (e, 3H) methyl group attached to $CH_3—C{=}CH_2$ 0.68 (s, 3H), 0.78 (s, 3H), 0.88 (s, 6H), 0.92 (s, 3H) 5 methyl groups; IR 1690, 1640, 3440 cm^{-1} (Found : C, 78.40; H, 10.84 ; $C_{30}H_{48}O_3$ requires C, 78.97 ; H, 10.52%). The mass spectrum showed the molecular ion m/e 456. The identity of this compound was confirmed by the direct comparison with an authentic specimen of betulinic acid, (m. p. ; mixed m. p. TLC).

Acetate of betulinic acid : The betulinic acid on acetylation with acetic anhydride pyridine at room temperature gave needles m.p. 278° (lit. 287—91)[3] $[\alpha]_D^{20} + 23°$ ($CHCl_3$) (lit. $[\alpha]_D^{20} + 22 \pm 2°$).[4] The NMR spectrum contained the following signals: δ 4.66 (d, 2H) J = 3Hz, 2 vinyl protons ; 4.45 (s, 1H) C_3 proton ; 2.0 (s, 3H) methyl of acetate, 1.7 (s, 3H) methyl group of $CH_3—C{=}CH_2$; IR, 1690, 1735, 1640 cm^{-1}. The mass spectrum showed the molecular ion of m/e 498 and the rest of the fragmentation pattern is identical to the pattern shown by Lupenes.[2]

Methyl ester of betulinic acid : The betulinic acid on methylation with excess diazomethane gave the methyl ester m.p. 218° from petroleum ether (lit 223°).[3]

Ellagic acid : From the cold methanolic extract of *S. racemosa,* ellagic acid was obtained, which after crystallisation from pyridine gave needles (m.p. 360°) identical with authentic ellagic acid (TLC).

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Changes in Polyphenols, Amino Acids and Volatile Compounds during Fermentation and Firing in Orthodox Processing of Tea

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(*Paper accepted* : 28 *November* 1978)

Abstract : In the orthodox manufacture of tea, prolongation of fermentation leads to a reduction in the solubility of the tea polyphenols due to increased binding with other tea leaf cell components ; the period of fermentation has no effect on total amino acid content. On firing, the bound polyphenol and the total amino acid contents increase and there is also a considerable loss of volatile compounds.

1. Introduction

Polyphenols, amino acids and volatile compounds play an important role in determining the character of tea[2,4] but detailed studies of the quantitative changes in these classes of compounds which occur at various stages of fermentation and on firing have received insufficient attention. As was first pointed out by Roberts,[1] polyphenols undergo dramatic transformations during fermentation, and the amino acids are converted to compounds which are partly responsible for the aroma of tea. It is also to be expected that some of the essential oils, which contribute in a significant way to tea flavour will be lost at the high temperatures employed in the firing stage of processing, but the extent of this loss is unknown. The present investigation presents the results of the first systematic study of the progressive oxidation of polyphenols and changes in the amino acid content, after various periods of fermentation, and the extent of loss of essential oils during firing.

2. Materials and Methods

Flush of clone TRI 2024 collected in dry weather during early February 1977, was tat-withered for 12 hours and rolled in orthodox mini-rollers having a capacity of 14 kg withered leaf. The leaf was first preconditioned for 10 min and then rolled under pressure for 15 min. First dhool* samples were removed after periods of fermentation of 30, 60, 90, 120 and 150 min. Part of each of these samples was fired, and each of the five samples of dhool and black tea respectively, analyzed for contents of total polyphenols, vanillin-reacting polyphenols, amino acids, and essential oils.

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*Dhools = fermenting leaf mass

2.1. Estimation of polyphenols and amino acids

Samples of dhool (10g) and fired tea (5g) respectively were extracted with 50 ml of boiling absolute alcohol for 10 min. The extract was decanted and the residue re-extracted twice more in a similar manner, after which the three successive extracts were pooled and made up to 250 ml. The residue after extraction was then extracted with boiling aqueous (80% v/v) alcohol three times successively, the successive extracts pooled, and made up to 250 ml. Each pooled extract was analyzed for total polyphenols and vanillin-reacting polyphenols according to the methods described by Swain and Hillis[3] and for total amino acids by the method of Yemm and Cocking.[6]

2.2. Estimation of essential oils

Essential oils were collected by steam distilling 200g samples of fermented dhool and 50g of the corresponding fired dhool. One thousand ml of steam distillate were collected, after which it was saturated with sodium chloride and the essential oils extracted with peroxide-free diethyl ether (3 × 100 ml). The ethereal extracts were dried with anhydrous sodium sulphate and the weight of essential oil determined after distilling off the ether at 38°C. Loss of essential oils was calculated on the dry weight basis of dhool and black tea.

3. Results

3.1. Total polyphenols

Analysis of total polyphenols extractable by absolute and aqueous alcohol, respectively, from dhools after periods of fermentation varying from 30 min to 150 min together with the results of analysis of the corresponding fired tea, are shown in Table 1.

Table 1. Changes with time of fermentation of total polyphenols in dhools and black tea (mg/g dry weight)

Time of fermentation	Absolute alcohol extract		Aqueous alcohol extract		Total	
(min)	Dhool	Black Tea	Dhool	Black Tea	Dhool	Black Tea
30	242	111	85	239	327	350
60	229	79	102	258	331	337
90	199	59	124	253	323	312
120	198	33	112	276	310	299
150	180	28	122	265	302	293

Total polyphenols estimated by the method of Swain and Hillis[3], using Folin-Ciocalteau reagent.

The results indicate that in dhools a greater proportion of polyphenols were extractable by absolute than by aqueous alcohol and that this pattern was reversed on firing. It is also seen that periods of fermentaion greater than 1 h lead to a decrease in the amount of extractable polyphenols and this trend is more marked in black tea than in dhools.

3.2. Vanillin-reacting polyphenols

Table 2 depicts the results obtained with vanillin-reacting polyphenols corresponding to those shown in Table 1 for total polyphenols.

TABLE 2. Changes with time of fermentation of vanillin-reacting polyphenols in dhools and black tea (mg/g dry weight)

Time of fermentation (min)	Absolute alcohol extract		Aqueous alcohol extract		Total	
	Dhool	Black Tea	Dhool	Black Tea	Dhool	Black Tea
30	125	50	41	120	166	170
60	106	39	44	121	150	160
90	98	28	49	113	147	141
120	88	18	48	121	136	139
150	77	14	49	116	126	130

Vanillin- reacting polyphenols estimated by the method described by Swain and Hillis.[3]

The results show the same trend as in Table 1 with regard to the differential extraction with absolute and aqueous alcohol. The decrease of extractability with increasing time of fermentation is also evident, but to a much greater degree than with total polyphenols.

3.3. Total amino acids

Table 3 shows the results of analyses for total amino acids in aliquots of the extracts previously examined for content of polyphenols.

TABLE 3. Changes with time of fermentation of total amino acids in dhools and black tea (mg/g dry weight)

Time of fermentation (min)	Absolute alcohol extract		Aqueous alcohol extract		Total	
	Dhool	Black Tea	Dhool	Black Tea	Dhool	Black Tea
30	8	5	5	16	13	21
60	7	4	6	16	13	20
90	6	3	6	17	12	20
120	6	3	7	17	13	20
150	7	3	6	16	13	19

Total amino acids estimated by the ninhydrin method of Yemm and Cocking,[6] by reference to a standard curve prepared with α—alanine.

The results show that firing leads to a decrease in total amino acids extractable by absolute alcohol, while the amount extracted by aqueous alcohol is significantly increased. It is also seen that firing leads to an increase in total amino acids, which is independent of the period of fermentation.

3.4. Essential Oils

Table 4 depicts the weight of steam distillable essential oils in samples of dhool before and after firing to black tea.

TABLE 4. Changes with time of fermentation of essential oils in dhools and black tea

Time of fermentation (min)	Dhool (mg/g dry wt)	Black Tea (mg/g dry wt)	% Loss
30	0.13	0.12	8
60	0.20	0.08	68
90	0.19	0.12	36
120	0.24	0.08	65
150	0.26	0.19	28

The results indicate that there is a considerable loss of volatile compounds on firing.

Discussion

The polyphenols, and particularly the vanillin-reacting polyphenols, are responsible for the brightness and quality of tea liquors and their progressive decrease as the period of fermentation exceeds 1 h confirms the undesirability of unnecessary extension of fermentation. The decrease is particularly relevant in the production of instant tea where a decrease in extractability would seriously impair the economic viability of the process technology.

The results of differential extraction with absolute and aqueous alcohol indicate that firing leads to binding of the polyphenols to other components of the tea leaf. Such binding is indicated in the finding that aqueous, but not absolute alcohol, extracts the greater part of the polyphenolic compounds. This interaction is the primary cause for the reduction of astringency in black tea as compared to dhools, and suggests that differential extraction could provide a laboratory method for monitoring changes of astringency with fermentation time.

The increase of amino acids on firing is due to chemical and enzymic hydrolysis of protein at the elevated temperatures used, and their easy solubility in aqueous alcohol suggests that these amino acids are, for the greater part, bound in complexes containing polyphenols, proteins, and other compounds. Such complexes are likely to make an important contribution to the colour of tea liquors, and their formation is one of the useful reactions which occur during firing.

Essential oils are the class of compounds which are mainly responsible for the aroma of tea, and their considerable loss during firing would, at first sight, appear to be a disadvantage. However, tea aroma is due to a very complex mixture of compounds, some of which detract from flavour,[4] and the loss of these detrimental compounds may be expected to result in improved flavour. Recent work[5] has provided a means of recovering the essential oils lost during firing, and it has been found that these include compounds which could be used to enhance natural tea flavour.

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Alkali Treatment of Paddy Straw. Effect of Energy and non-protein Nitrogen Supplementation on Digestibility and Intake by Sheep

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Abstract : A feeding trial with crossbred sheep, to investigate the influence of energy and non-protein nitrogen supplementation of sodium hydroxide treated paddy straw, on digestibility and voluntary intake, is reported. Untreated or treated straw supplemented with urea in concentrate, urea in concentrate and molasses, or urea dissolved in molasses were compared. The treatment having urea in concentrate carried 18 g urea/100 g concentrate while the treatment having urea in molasses contained 3.6 g urea in 7.0 ml of molasses diluted in 100 ml water/100 g straw. Molasses solutions were sprayed in the same manner as sodium hydroxide. Alkali treatment significantly increased both dry matter and organic matter digestibility. Addition of molasses increased the digestibility of untreated straw but depressed the digestibility of treated material. However, supplementing alkali treated straw with molasses increased dry matter intake by 34% compared to untreated material. Combining urea with molasses did not result in any additional advantage. It is concluded that alkali treatment can substantially increase the feeding value of paddy straw. Addition of molasses as practised in factory-scale production of treated straw pellets may lead to an increase in digestible energy intake and a higher energy balance.

1. Introduction

A major limiting factor in the production of high quality proteins through animal agriculture is the shortage of suitable feedstuffs for these animals. This is particularly true to Sri Lanka where the tropical climate encourages rapid growth and the subsequent overmaturity of plant material suitable for livestock raising. However Sri Lanka, like many developing countries, produces large quantities of highly lignified plant byproducts, such as paddy straw, sugar cane bagasse and grain hulls, which are high in energy yielding cell wall material, but often little used as feedstuffs for ruminants.

Paddy straw the largest annually harvested agricultural by product in Sri Lanka, is little used as an animal feed because of its low nutritive value. Chemical procedures have been elaborated in recent years for upgrading poor quality roughages[2,3,8,12,14], and sodium hydroxide (NaOH) treatment has been claimed to be the most effective.[5,11] Recent trials in Sri Lanka[7] have indicated that paddy straw can be successfully upgraded in feeding value, to a medium quality hay by spray treatment with sodium hydroxide solution.

The experiment presented in this paper was designed to investigate, the influence of energy and non-protein nitrogen supplementation of sodium hydroxide treated paddy straw (variety H4), on digestibility and voluntary intake by sheep. 6 g of

NaOH dissolved in 120 ml H_2O/100 g straw was selected as the level of treatment, as results from the previous trial[7] suggested that optimal treatment level for paddy straw variety H_4 would be between 4 to 8 g of NaOH carried in 120 ml H_2O/100 g straw.

2. Experimental

Paddy straw, variety H_4, chopped into 20 to 50mm lengths, was treated with 6 g of NaOH dissolved in 120ml water per 100 g straw according to the method previously described[7] but without neutralization of excess alkali. The experiment was designed as a completely randomized block experiment with six treatments, each treatment having three replicates. Treated or untreated straw was supplemented with urea, either in concentrate component of the ration or sprayed along with molasses, (viscosity—14,500 centipoise, at 26.5°C, density—1.37 g/cm^3) (Table 1). The molasses solutions were sprayed in the same way as sodium hydroxide. Urea (18 g/100 g concentrate) when added increased the crude protein equivalent of the concentrate (ground maize) to 60%.

Air dried treated or untreated straw was given to appetite in amounts 10% greater than the previous days intake. The amount of concentrate supplementation was fixed (100 g/animal/day) and contributed approximately 20% of the total dry matter intake.

The digestibility of straw rations were determined using Jaffna Bikaneri female sheep of average live weight 23.0 kg. All animals had access to *ad libitum* water and a standard mineral mixture (bone meal, shell grit powder and salt in the ratio of 5 : 3 : 2) throughout the experimental period.

Housing of animals collection of faeces and urine and sampling of feed for chemical analysis was as described earlier.[7] In addition to dry matter, ash, crude protein and crude fibre, samples were also analysed for acid detergent fibre, cellulose and silica by the method of Goering and Van Soest.[4]

The digestibility of straw organic matter was calculated by assuming the organic matter digestibility of the concentrate to be 85%.

TABLE 1. Composition of rations used in the feeding trial

Ingredients	Treatments					
	Untreated straw			Treated straw		
Treatment number	1	2	3	4	5	6
Amount of NaOH (g/100 g straw)	0	0	0	6	6	6
Volume of water (ml/100 g straw)	0	0	0	120	120	120
Quantity of molasses (ml/100 ml water)	0	7.0	7.0	0	7.0	7.0
Amount of urea in molasses (g/100 g straw)	0	0	3.6	0	0	3.6
Concentrate fed with straw (g/animal/day)	100	100	100	100	100	100
Amount of urea in concentrate (g/100 g concentrate)	18.0	18.0	0	18.0	18.0	0

TABLE 2. The average chemical composition of concentrate and treated straws used in the feeding trial.

	Treatments						
	Untreated straw			Treated straw			Concentrate
Treatment number	1	2	3	4	5	6	
Dry matter (g/100 g straw)	95.1	94.6	94.8	94.8	94.6	93.9	91.2
Energy value (MJ/kg DM)	15.03	19.08	17.61	15.15	15.83	17.53	—
				(g/100 g dry matter)			
Ash	15.4	14.3	14.7	16.6	16.3	16.4	1.48
Crude protein	3.4	3.6	6.9	3.8	3.5	6.8	9.7
Crude fibre	30.4	30.3	29.3	30.5	32.8	31.7	2.2
Acid detergent fibre	60.8	53.6	54.3	51.4	51.4	50.2	—
Cellulose	40.3	37.9	36.1	36.5	36.4	35.9	—
Silica	12.9	12.4	12.7	12.4	10.8	12.6	—

3. Results

The composition of straw rations and concentrate are shown in Tables 1 and 2. The consumption of treated straw had no adverse effect on the health of animals.

Alkali treatment of straw significantly ($P < 0.001$) increased both dry matter and organic matter digestibility. Addition of molasses appeared to increase the digestion coefficient of untreated straw (though not significantly) but depressed the digestion coefficient of treated material. Combining molasses with urea did not result in any additional increase in digestibility than molasses alone.

The maximum intake of straw was attained in about 10 days and remained fairly constant thereafter. Though alkali treatment by itself did not significantly increase the intake of straw dry matter, supplementing alkali treated straw with molasses increased dry matter intake by 34% compared to untreated material. An increase in dry matter intake was also observed with untreated material when molasses was added to it, but this increase was proportionately lower than the increase in intake observed with treated material (Table 3).

The consumption of treated straw did not influence the voluntary intake of water and the output of urine.

4. Discussion

The derived digestibility of untreated straw organic matter in the present experiment was higher than the value reported earlier[7] for the same variety of straw. This could be presumably due to the fact that the straws came from different harvests.

Although alkali treatment significantly ($P < 0.001$) increased the organic matter digestability of straw, the response to treatment was lower than the values reported earlier (17 vs 19 to 28 percentage digestibility units) for paddy straw variety H_4 treated under similar conditions.[7] This could be due to the higher initial digestibility of the straw. As suggested by Mwakatundu[9] and Jayasuriya,[6] response to alkali treatment could be inversely related to the digestibility of the untreated straw. Similar observations were also made by Jayasuriya and Owen[8] for barley straw treated with a dilute solution of sodium hydroxide by a method similar to that of Beckmann.[1]

The depression in digestibility of molasses supplemented treated straw diets could have been due to the higher intake recorded in these treatments. It is also possible that the presence of a readily available source of energy was detrimental to rumen microorganisms leading to the depression in digestibility. The combination of molasses with urea did not result in an increase in digestibility than urea alone (Table 3), presumably because of lack of any additive effect of these two nutrients.[3]

TABLE 3. Intake and apparent digestibility of dietary constituents.

	Treatment Number						S.E. of difference between means.
	Untreated straw			Treated straw			
	1	2	3	4	5	6	
Crude protein in ration (g/100 g dry matter)	13.0	13.59	7.31	13.62	12.17	7.20	—
Estimated metabolizable energy content of ration (MJ/kg DM)	8.31	7.95	7.78	9.30	8.65	8.62	—
Digestibility of dietary constituents (%).							
Dry matter (DMD)	52.9	54.0	52.1	65.8	61.2	61.1	± 1.75
Organic matter (OMD)	56.6	58.9	57.9	70.4	65.5	65.3	± 1.77
Digestible organic matter in dry matter (DOMD)	53.3	51.7	50.6	60.4	56.2	56.0	—
Derived digestibility of straw organic matter	49.9	53.2	52.4	67.0	61.9	61.5	± 2.33
Intake							
Ad libitum intake of straw (excluding added ash) (g dry matter/animal/day)	425.4	481.9	533.5	489.8	570.2	565.5	± 47.6
(g dry matter/kg $W^{0.75}$ / day)	40.3	45.7	50.6	46.5	54.1	53.7	± 4.5
Intake of concentrate (g dry matter/kg $W^{0.75}$/day)	8.6	8.6	8.6	8.6	8.6	8.6	—
Intake of water (voluntary intake —1/day)	2.370	1.543	1.307	2.500	2.357	2.833	± 0.866
Output							
Urine (1/day)	1.133	0.717	0.450	1.440	1.180	1.603	± 0.539

In contrast to the findings reported earlier[7] alkali treatment in the present experiment did not bring about a significant improvement in dry matter intake. It is possible that the higher level of sodium hydroxide used (6 g in the present experiment compared to 4 g/100 g straw in the former) influenced dry matter intake. It has already been suggested,[10] that high levels of sodium hydroxide in treated straw may increase the osmotic pressure in the rumen liquor leading to an inhibition in microbial activity. This in turn could reduce the rate of passage of digesta and influence voluntary intake. As suggested by Rexen and Thomson,[12] the most appropriate sodium hydroxide dosage would therefore be around 4 g/100 g straw.

The factory-scale manufacture of treated straw pellets would often necessitate the use of molasses,[5] to function as a binding agent as well as to mask the unpleasant flavour of urea that may have to be added to the treated material at the time of processing in order to raise the crude protein equivalent of the finished product. In this context, it is important to note the increase in voluntary intake due to the addition of molasses to alkali treated straw, despite a lowering in digestibility. A greater intake even with a lower digestibility would often mean a higher energy balance when the material fed is in ground and pelleted form.[13]

The estimated metabolizable energy (ME) content of about 8.86 MJ/kg DM (Table 3) suggests that the treated straw diets in the present experiment could be comparable in feeding value to a grass hay of moderate to high digestibility. A material of such feeding value when given to appetite would be able to satisfy both maintenance and production energy requirements of a 400 kg cow producing 10 kg milk/day. Thus, treated straw appears to have considerable application as a replacement for good quality fodder in most dairy cattle rations.

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Some Chemical Characteristics of Fresh and Salt-Dried *Tilapia mossambica* Peters

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Abstract : Some chemical characteristics of fresh and salt-dried product of *Tilapia mossambica* Peters were studied. *Tilapia* was found to have a much higher carbohydrate content than other fishes hitherto analysed, and this is correlated to its feeding habits. It appears that there is a loss of protein and carbohydrate in the preparation of its salt-dried product. It is suggested that this loss may be due to the leaching out of soluble proteins and carbohydrates into the brine solution in which the fish are soaked overnight in the process of preparation. The amounts of protein, carbohydrate and ash in the salt-dried product was found to be significantly different from that of the fresh muscle. The calorific value of the salt-dried product, gram for gram, was found to be about 1.8 times that of the fresh fish.

1. Introduction

The chemical composition of fish is known to be dependent on a number of environmental factors, both physico-chemical and biological.[9] Most studies on the chemical composition of fish have been carried out on marine species and on anadromous salmonids. Studies on freshwater fishes are rare and few.

Studies on the chemical composition of a number of species of fish from Sri Lanka, both marine and estuarine, have been carried out by Lantz and Gunasekera[8] and Peiris and Grero.[14,15] However, these workers based their determinations on a single sample of a number of individuals pooled together of each species and did not attempt to correlate their findings to size or to any other variable. Perera and de Silva,[13] on the other hand, studied the chemical composition of young grey mullet, *Mugil cephalus* L., with a view of evaluating the effect of food regime and salinity on the chemical composition. Urugoda and Kottegoda[17] estimated the histidine content of skipjack tuna in an attempt to correlate adverse reactions to the drug isoniazid in groups of patients with a high histamine content in the blood as a result of consumption of skipjack tuna.

Tilapia mossambica Peters is an exotic species which was introduced into Sri Lanka in 1952.[5] This species has primarily contributed for the increase in inland fish production over the last decade, which at present accounts for 10% of the total, and still is the mainstay of the freshwater fisheries, particularly in the dry zone reservoirs.[10] However, the total daily catch is not marketed as fresh fish and a significant proportion is converted into its salt-dried product, mostly along the banks of the reservoirs.

This paper is the first of a series initiated to investigate the chemical characteristics of fishes of Sri Lanka and their products and also to evaluate the effects of environmental factors on the same. In the present paper, the results of studies on some chemical characteristics of *T. mossambica* and its salt-dried product are presented.

2. Materials and Methods

All fish used in the present study were obtained from fishermen at the time of capture, from the Colombo (Beira) lake. Fish were brought to the laboratory in ice and the total length and the gutted weight for individual fish determined, the former to the nearest 5mm and the latter to the nearest 0.1g. A random sample of the collection was used for chemical analyses of fresh fish and the remainder was utilized for the preparation of the salt-dried product.

For chemical analyses of fresh fish, individual fish were filleted, and from the right fillet a portion of the muscle, devoid of skin and bone, from the centre was taken, weighed to the nearest mg and dried at 80° to a constant weight. From these data, the moisture content of the muscle was obtained. For determination of other constituents, the dried muscle was finely ground using a Potter-Elvehjem homogeniser and aliquots of the ground material were used.

Salt-dried fish were prepared according to the methods adopted by the fishermen of Parakrama Samudra, Polonnaruwa. The gutted fish were scaled and washed well and split into two. The split fish were put into a fine cloth, containing ground common salt and shaken either way for about 10 minutes, until the fish were well coated with salt. The salt coated fish were then kept overnight in a brine solution (3 : 1 by weight) and then dried in the sun for 3 days until it was crisp to touch. From the salt-dried fish, a portion of the muscle was taken from the corresponding region as earlier, from the right half, and dried in an oven at 80° to a constant weight. The dried muscle was finely ground and aliquots used for chemical determination.

The chemical determinations that were carried out were for protein, carbohydrate and total lipid. Protein was quantified according to Raymont *et al*,[16] carbohydrate according to Dobois *et al*[3] both spectrophotometrically and lipid using the gravimetric method of Folsch *et al.*[7] For the estimation of protein, carbohydrate and lipid 40 to 50mg, 5 to 10mg and 80 to 100mg of dried material respectively, were used. All determinations were carried out in triplicate. The standards used in the estimation of protein and carbohydrates were bovine serum albumen and glucose monohydrate, respectively. Ash content was determined by combusting 200 to 300mg aliquots of the dried muscle at 500° for 12 h in a muffle furnace.

3. Results

All results are expressed, in the present study, as percentage of the moisture free muscle, in relation to the fresh fish weight or the salt-dried fish weight as the case may be.

The moisture content of fresh and salt-dried muscle of *T. mossambica* plotted against the wet weight of fish is shown in Figure 1. It is evident from the figure that in fresh muscle there is a decrease in the percentage of water with increasing weight of the fish while the reverse occurs in salt-dried fish.

As the percent protein, carbohydrate, total lipid and ash appeared to show a tendency to decrease or increase, as the case may be, with increasing fresh fish weight and salt-dried fish weight, the linear relationship of the latter to the above parameters, were calculated and are given in Table 1 for each type. However, it is seen that the increase or decrease of any of the components, either with fresh or dried-fish weight, as the case may be, is small as indicated by the slopes and is not statistically significant in any of the instances.

TABLE 1.—Statistical relationship of different constituents to fish weight in fresh and salt-dried *Tilapia mossambica* and statistical significance of the relationships.

Constituent	Fresh fish	Salt-dried fish	Significance Fresh	 Salt-dried
% Moisture	$-0.01\,X + 79.43$	$0.37\,X + 20.95$	n.s.	5%
% Protein	$0.006X + 74.68$	$0.10\,X + 56.6$	n.s.	n.s.
% Carbohydrate	$0.03\,X + 9.71$	$0.004X + 3.93$	n.s.	n.s.
% Total lipid	$-0.01\,X + 4.45$	$0.04\,X + 2.31$	n.s.	n.s.
% Ash	$-0.01\,X + 7.73$	$-0.05\,X + 32.05$	n.s.	n.s.

Because of the above observations and for easy reference and comparisons the mean and standard deviation for each of the components for the two groups are given in Table II. Also included in the Table are results of statistical tests carried out to test for the significance of the difference between the means of fresh and salt-dried muscle for each chemical component. It is clearly evident that the difference observed between the means, except for total lipid, for each component is significantly different in the two types of muscle. The relationship of the yield of salt-dried fish to the original fresh weight is shown in Figure 2. It is evident from the figure that in the preparation of the salt-dried product of *T. mossambica* there is approximately a 50% loss in weight.

From Table I and Table II, it is evident that there is significantly a higher percentage of protein and carbohydrate in fresh fish compared to salt-dried fish, the latter having a higher proportion of ash.

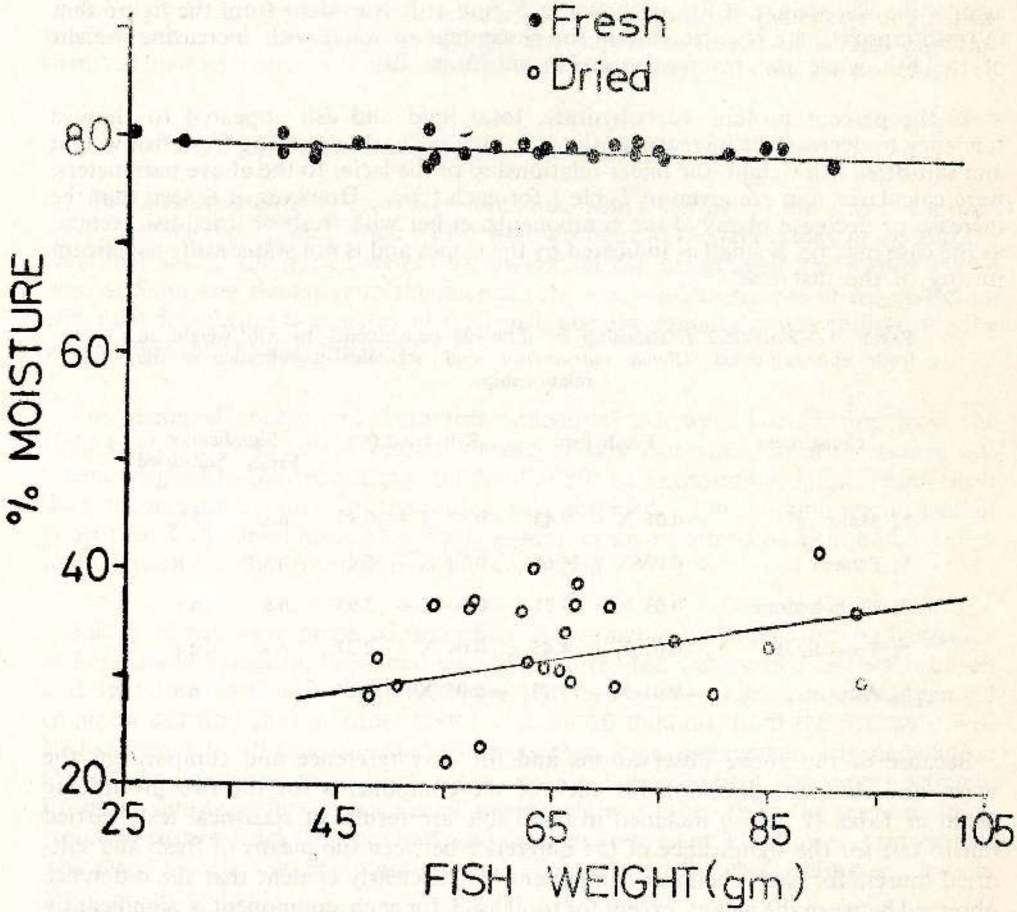

Figure 1. Relationship of percent moisture to fish weight of fresh and salt-dried *Tilapia mossambica.*

TABLE 2.—The mean, range and standard deviation of different chemical constituents of fresh and salt-dried *Tilapia mossambica* and results of analysis of variance to test the significance of the differences in the means for each component.

(Results are expressed in % moisture free weight, where relevant)

	FRESH			SALT DRIED			d.f.	t	p
	Mean	Range	S.D.	Mean	Range	S.D.			
PROTEIN	76.65	67.82 — 81.26	2.53	63.44	43.41 — 67.63	5.04	39	2.4	0.01
CARBOHYDRATE	11.66	9.33 — 15.60	2.07	4.07	2.67 — 4.68	0.79	46	3.04	0.001
TOTAL LIPID	4.05	2.01 — 5.04	0.96	3.62	2.71 — 5.02	0.71	47	13.86	n.s.
ASH	6.92	4.38 — 7.94	1.16	29.92	24.7 — 35.95	3.79	50	0.37	.001

4. Discussion

Very few authors have attempted to treat the variation of individual constituents to the size of fish. Balbontin *et al.*[1] too found that percentage of protein, carbohydrate, total lipid and ash to vary only slightly with growth in both wild and reared, young herring. Similar conclusions were arrived at by Perera and de Silva[13] for *M. cephalus* and by Ehrlich[4] for larval plaice.

Considering the chemical composition of fresh *T. mossambica* it is evident that there is a decrease in percent moisture with growth. This is a general phenomenon known for fish, and have been recognised for almost all fish species studied. Balbontin *et al.*[1] even recognised different phases in the life-cycle of herring where the moisture content decreased at different rates with growth.

The most striking difference in the chemical composition of *T. mossambica* when compared to other fishes, for example herring, grey mullet, plaice, cod, etc. is the comparatively high carbohydrate content of its muscle (mean 11.66%; s.d. 2.07). Carbohydrates are generally stored in the liver as glycogen as well as in fish muscle.[9] Fish[6] has shown digestion of carbohydrate to be more efficient in *T. mossambica*, a herbivore, than in *Perca fluviatilis*, a carnivore. Nagasse[12] working on the same species has shown that lipase activity but not protease activity was affected by the diet ; the activity of lipase increasing significantly when fed on a carbohydrate rich diet. These authors, however, did not estimate the carbohydrate content of the muscle. It is known that the diet may influence the chemical nature of the muscle.[9] The ability to digest cellulose has been demonstrated for at least one species of Tilapia viz. *T. nilotica*.[11] It is conceivable that *T. mossambica*, which feed on a rich cellulose diet (Costa and Abayasiri, in the press), has a correspondingly higher carbohydrate content in its muscle.

The low level of total lipid indicates that *T. mossambica* is a 'non-fatty' fish. It is further exemplified by Figure 3, which shows an inverse relationship of percent moisture to protein, that is typical of non-fatty fishes. Similarly, the percent ash in the muscle

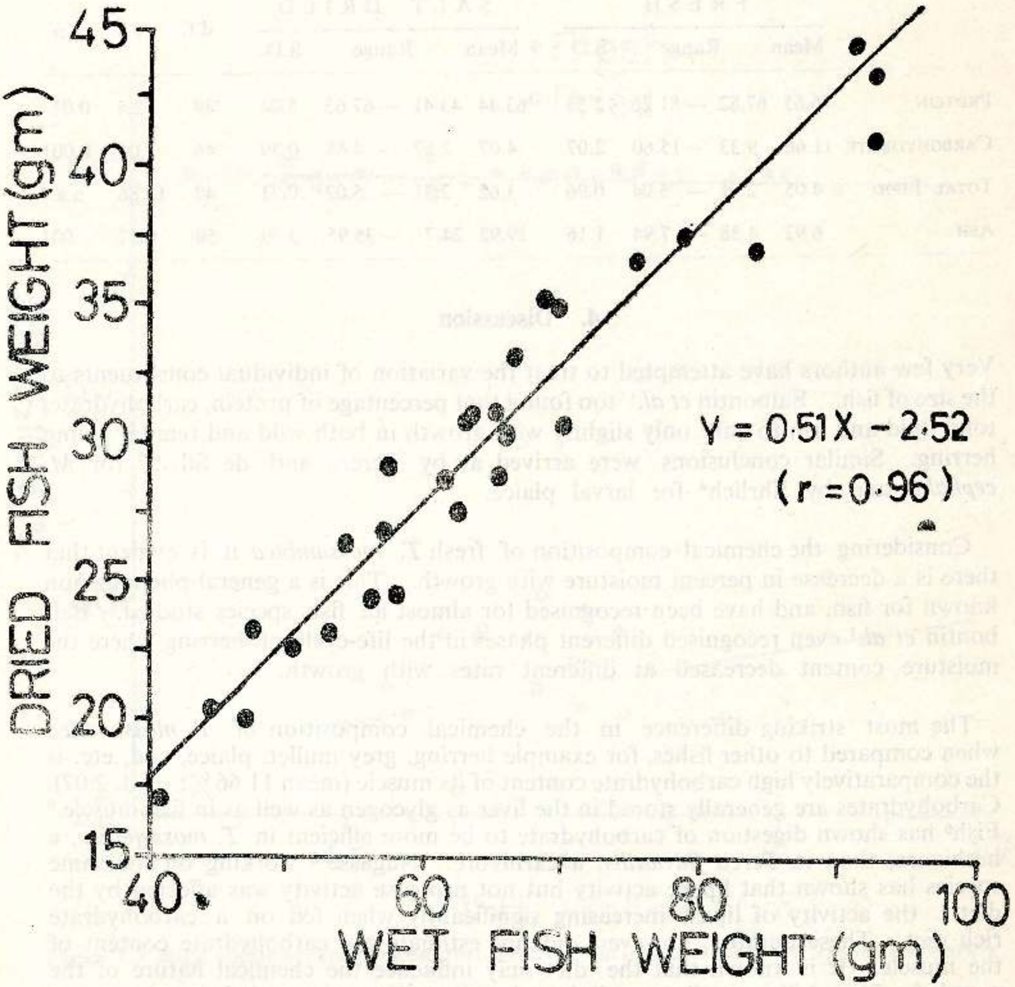

Figure 2. Relationship of the salt-dried fish weight to its original fresh weight.

of *T. mossambica* is lower than that known for marine and estuarine species. It is known that although the relative ionic composition of all animals tend to be the same, the total ionic compositon tends to be higher in marine and estuarine species, as reflected by the osmotic pressure.

When the salt-dried product is taken into consideration, the most striking difference is the significant reduction in protein and carbohydrate as opposed to ash. It is obvious when results are expressed in percentages, that even when there is an absolute increase in only one of the components, the others must decrease correspondingly. It is possible that in the preparation of the salt-dried product, particularly when the fish is soaked overnight in a strong brine solution, there could be a leaching out of a certain proportion of soluble proteins and carbohydrates from the muscle and an influx of sodium chloride. When the process of preparation was repeated with a fresh batch of fish and the brine solution tested qualitatively for the presence of protein and carbohydrate, it was found to be positive as opposed to the control solution.

Waterman (1976) in his review on the preparation and quality of dried fish, has pointed out that the amount of salt that is incorporated into the fish is a determining factor of the shelf-life of the product. It would be profitable to investigate the optimum salt content that is necessary for maximum shelf-life for different species of fish, so that it may be possible to reduce the soaking time for the fish in brine. Moreover, this could result in bringing about a reduction of the amounts of protein and carbohydrate leaching out, but at the same time not sacrificing its shelf-life. The low level of fat in the muscle of *T. mossambica* proves it to be an ideal species for conversion into dried-fish, as it would not tend to turn rancid for a long time.[18]

Finally Table III gives a comparison of the calorific value in Kcals, computed by using conversion factors recommended by the International Biological Programme,[19] (protein 5.5. Kcals/g ; carbohydrate 4.1 Kcals/g ; lipid 9.5 Kcals/g), of 100 g of fresh *T. mossambica* and 100 g of the salt-dried product is about 1.8 times that of the fresh fish. However, this alone does not convey the whole picture. It is known that according to our normal eating habits the weight of dried fish consumed at a normal meal is about one-fourth that of fresh fish. Further, dried fish is almost always more expensive than its fresh counterpart. Therefore, it appears that nutritionally it will be more profitable to eat fresh fish when the choice is available, at least in the case of *Tilapia*. It would be interesting to investigate whether there is a parallel difference in the nutritive value of salt-dried product of other species of fish.

TABLE 3.—Composition and the corresponding calorific value of 100g of fresh and salt-dried *Tilapia mossambica*

	CONSTITUENT										
	Water		Protein		Carbohydrate		Lipids		Ash		Total
	g	Kcals	g	Kcals	g	Kcals	g	Kcals	g	Kcals	Kcals
Fresh muscle	78.25	—	16.06	80.8	2.77	11.36	1.85	9.88	1.51	—	102.12
Salt-dried muscle	58.55	—	27.56	151.58	1.79	7.33	2.71	25.65	9.76	—	184.56

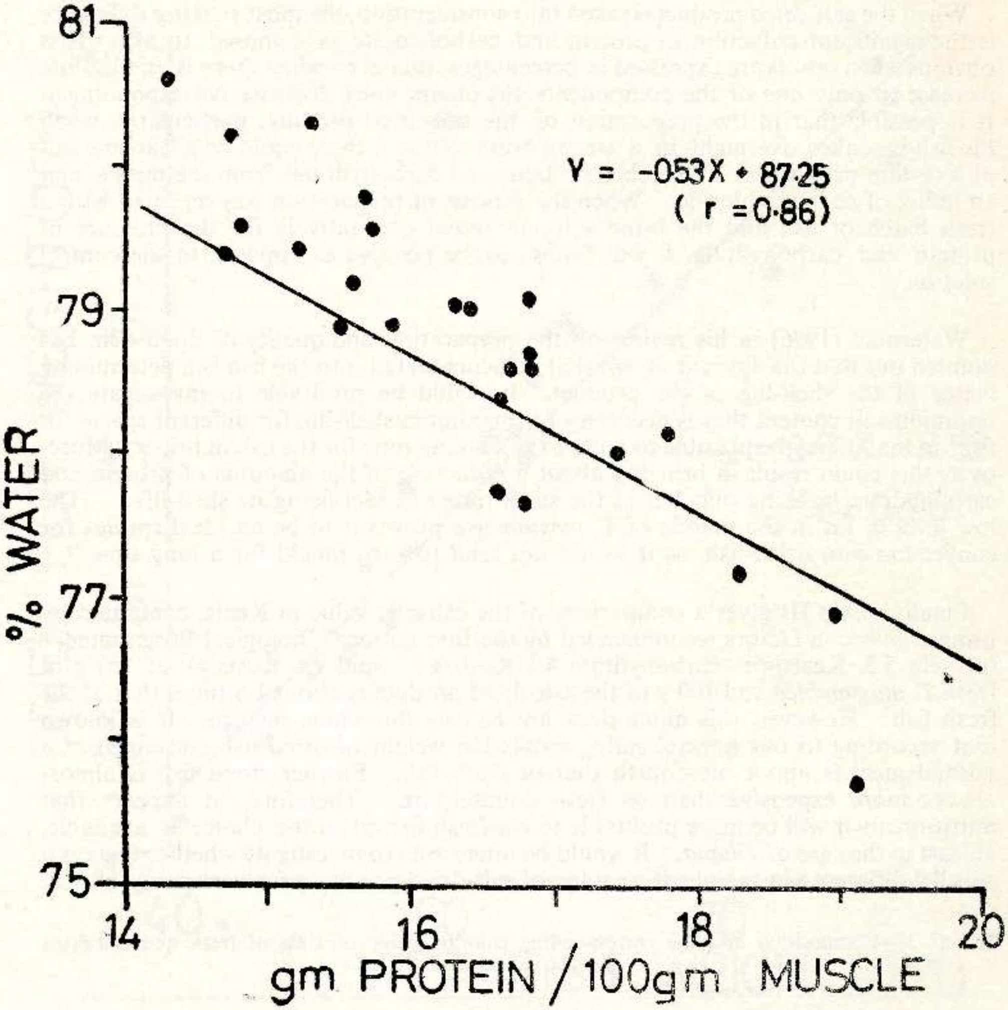

Figure 3. Relationship of percentage water to the protein content of fresh *T. mossambica.*

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Cyanocobalamin in Human Cord Blood and Family Income

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Abstract : Cyanocobalamin levels were determined in human cord blood obtained from 23 mothers of very low family income and 31 mothers of average income. The cyanocobalamin content of cord blood in the very low income group was found to be significantly less than that of the average income group.

1. Introduction

Cord blood is known to contain more cyanocobalamin than comparable maternal blood.[1] It is also known that, in some species, nutritional deprivation of the mother during the second half of pregnancy results in small placentas.[3] In this investigation, cord blood cyanocobalamin content of two socio-economic groups were compared.

2. Materials and Methods

Placentas and cord blood were obtained from 54 subjects at the time of delivery. They were from the General Hospital, Kandy. The criteria for classification was family income. Monthly family income of Rs. 250/- or less has been considered as very low income and a monthly income of Rs. 300/- to Rs. 600/- as average income. Twenty three subjects belonged to the lower income group.

From each placenta, excess blood was blotted off, the membranes trimmed, the umbilical cord cut within 2 cm of it's origin and the weight determined. Cord blood was allowed to clot, serum separated and stored at —20°C. Maternal weights and birth weights were also recorded.

The cord blood cyanocobalamin levels were determined by the method of Green *et al.*[2]

3. Results and Discussion

Table 1 compares the maternal weight, birth weight, placental weight and cord blood cyanocobalamin levels for the two income groups. The lower income group had a significantly lower cord blood cyanocobalamin level than the average income group. The maternal, birth and placental weights were also lower, but not significant. There was no significant relationship between cord blood cyanocobalamin level and placental weight.

TABLE 1. Comparison of Maternal Weight, Birth Weight, Placental Weight and Cord Blood Cyanocobalamin of the two Income Groups.

		Monthly Income	
		Less than Rs. 250/-	Between Rs. 250/- and Rs. 600/-
Maternal weight (Kg)	mean ± S.D.	47.5 ± 4.2, N = 20	49.9 ± 5.4, N = 30
Birth weight (g)	mean ± S.D.	2691 ± 445, N = 23	2774 ± 382, N = 29
Placental weight (g)	mean ± S.D.	358 ± 87, N = 23	385 ± 87, N = 31
Cord blood cyanocobalamin, (pg/ml)	mean ± S.D.	468 ± 254*, N = 22	652 ± 348*, N = 30

*Significant difference, t = 2.118, significance level = 0.05.

N = Number of subjects.

The average cord blood cyanocobalamin content in the present series is less than that reported by Rosenthal and Wilbois.[4] Such variations are to be expected in the light of differences in racial, economic and nutritional factors.

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Field Distillation of Cinnamon Leaf Oil

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(*Paper accepted : 13 February 1979*)

Abstract : The distillation of cinnamon leaf oil in Sri Lanka is an important industry with a business turnover of at least Rs. 20 million/annum. However, none of the distillation systems employed at present are efficient. This paper deals with field studies made on traditional systems of distillation as well as the CISIRILL Manakoka. It also details the design and testing of a new condensing system which has resulted in a cinnamon leaf oil still (called the CISIRILL Boitaré) that has proved to be far more effective than any other essential oil still now in operation.

1. Introduction

The distillation of cinnamon leaf oil has a long history in this country, covering a period of more than half a century. The industry, which comprises small cottage type stills, is still expanding and as many as 160 stills were in operation in 1978. Put in more meaningful terms, this amounts to 225 still body units each capable of using 250 to 350 kg/leaf. The technology and distribution of stills and availability of raw material (which have been described in detail elsewhere[2]) shows the following salient features. (1) Most of the cinnamon leaf (a by product of the cinnamon bark industry) available is used for the distillation of leaf oil whilst about 20% to 30% of the leaf being either unused or used as fertiliser. (2) There are 4 types of stills in the field which are used for the distillation of cinnamon leaf oil : (*a*) the traditional cinnamon leaf type A still (Negombo), (*b*) the traditional cinnamon leaf type B still (Ambalangoda-Galle), (*c*) the traditional citronella type still (Galle-Matara) and (*d*) the CISIRILL Manakoka. The design of these stills has been described elsewhere.[2]

It was recognized in 1970 that the industry would be greatly benefited by the design of a cheap and efficient still ; a situation which led to the design and construction of the CISIRILL Manakoka.[3]

The basic rationale used for the design of the C. Manakoka was threefold. (1) In the dry zone (Hambantota), the distillation of citronella leaf oil was often curtailed due to lack of water therefore a water sparing still would be of tremendous benefit to the country. (2) Reduction of the size of the static water condensor eliminated the need for the costly large ground tanks, which are used for condensation in the

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*Soviet Consultant Engineer on loan to CISIR.

traditional cinnamon type B and the traditional citronella type and so reduces the cost of construction of the distillation system. (3) Upgrading the technology of the industry by improving still designs and using more suitable materials of construction which would lead to increased yield and a better quality of oil. The system had been applied to all leaf essential oil distillations (cinnamon, lemon grass, citronella and eucalyptus) available in the country.

However, the system did not work as envisaged, due to malfunction of its condensing system resulting in frequent overheating of distillate. In addition, studies done in this laboratory very clearly showed[1] that the rate of distillation plays a very important role in the recovery of cinnamon leaf oil ; good recoveries were possible only with high rates of distillation. Therefore, it was imperative that any new system of distillation should have an efficient condensing system.

This paper describes field studies made on the traditional systems of distillation and the CISIRILL Manakoka which led to the design of the new still, the CISIRILL Boitaré (modified Manakoka). The trials carried out with this new still are also reported.

2. Experimental

2.1. Field Distillations.

In these experiments, the stills were operated by the authors. Measurements taken were : (i) furnace temperature (by a pyrometer), (ii) rate of distillation, (iii) rate of oil recovery, (iv) temperature of distillation, (v) temperature of condensor water and (vi) mass of charge.

2.2. Determination of Yield and Efficiency.

Yield (% V/W) was calculated by measuring total charge of leaf (kg) and total yield of oil (litres). Efficiency of oil extraction was calculated by sampling the leaves used for the distillation[1] and carrying out a laboratory distillation of the leaves and twigs for oil content (after separation and determination of leaf : twig ratio) by the methods described previously.[1] Efficiency was then calculated by the following equation.

$$\text{Efficiency} = \frac{\text{Yield of oil (\% V/W) in field}}{\text{Yield of oil (\% V/W) in laboratory}}$$

3. Results and Discussion

3.1. Field Trials on Traditional systems

Studies on traditional system A (Dalugama still) showed that the condensing system was ineffective and overheating of distillate occurred towards the end of the distillation. Yields of 0.6% to 0.75% were observed. Distillation time was 8h to 10h and only one distillation could be done per day (the limitation being the condensor).

In traditional system B (Ambalangoda), a field trial was carried out on a still in Meetiyagoda and results contained in summary form appear in Table 1. No detailed studies were done on traditional system C (Citronella type), but it was observed that yield was very low 0.4% to 0.6%. Both types B and C have the disadvantage of having high costs of construction, mainly due to their static water condensors which are ground tanks of upto 10,000 gallons capacity.

TABLE 1. Field Distillation of Cinnamon Leaf Oil
Typical Results

System	Time of Distillation (hours)	Yield (%)	Efficiency (%)
1. Traditional	7	1.08	63
2. Manakoka (1)	7	0.65	41
3. Manakoka (2)	7	0.77	45
4. Manakoka (3)	6.5	0.78	49
5. Manakoka (3)*	6.5	1.15	67
6. C.Boitare	5	1.25	72
7. C.Boitare	4	1.25	72

***Higher rate of distillation with changes in condenser water.**

3.2. Field Trials on the Manakoka

The main principle of the condensing system of the Manakoka was that most of the heat from the vapours would be transfered to the water of the latent heat exchanger (static water condensor of 400 gallons capacity). The condensed water would then be cooled in the air condensor. However, in practice, this did not work as envisaged at rates of distillation of above 800 ml/min, when there could be drastic overheating of the distillate (Table 2).

Field trials have shown that the main problem of the Manakoka was that the latent heat exchanger was faulty, because :

1. the capacity of the static water tank was too small,
2. the arrangement of the condensing coils was not satisfactory,
3. the length of condensing coil was insufficient.

TABLE 2. A Typical Manakoka Field Trial

Time (h)	Rate of Distillation (ml/min)	Yield of Oil (ml/min)	Temperature of L.H.E. (°C)	Temperature of Distillate (°C)
0.25	780	0.5	61	33
0.5	840	2.5	63	33
0.75	700	6.0	68	34.5
1.0	510	5.1	74	33
1.25	580	5.3	78	34
1.50	560	7.0	80	35
1.75	870	11.0	80	36
2.0	530	7.0	82	34
2.25	720	9.0	84	37
2.5	380	8.0	85	39
2.75	500	7.0	85	37
3.0	800	7.0	86	47
3.25	1020	18.0	86	91
3.75	680	2.0	88	70
4.25	800	0.5	84	60
4.75	550	1.5	86	60
5.5	330	2.5	89	50
6.0	625	5.5	90	98
6.75	570	1.0	89	64

Total charge = 702 lbs, Yield of oil = 3½ bottles (7 hours),
% yield = 0.77 after 7 hours distillation.

3.3. Design and Functioning of a New Condensor

Studies in the laboratory showed that the arrangement of condensing coils was the vital factor in the system. Using 2 gallon scale models of the condenser, it was found that if the condensing coils were evenly distributed or positioned at the bottom of the tank, then the water in the tank (and the condensate) is gradually heated up by the steam (produced by a steam generator) and after a short time (2h) the temperature of the tank reached 90°C and condensation did not take place. On the other hand, if the coils were arranged mainly on the surface of the tank then most of the heat is transfered to the upper surface of the static tank from which evaporation can take place. Distillation could then proceed for a much longer time (4h) before the distillate became overheated.

Using this principle a new condenser was designed and incorporated into an old Manakoka system still, where this condenser replaced the Latent Heat Exchanger and the air condenser. This system has been named the Prototype CISIRILL Boitaró where the dimensions of the condenser are as follows :

1. Size of static water tank — 1000 gallons (450 L)
2. Length of condensing tube — 90 ft (30 M)
3. Diameter of condensing tube — 2″(5cm) for 40 ft (13 M) and 1″ (2.5cm) for 50 ft (16 M)

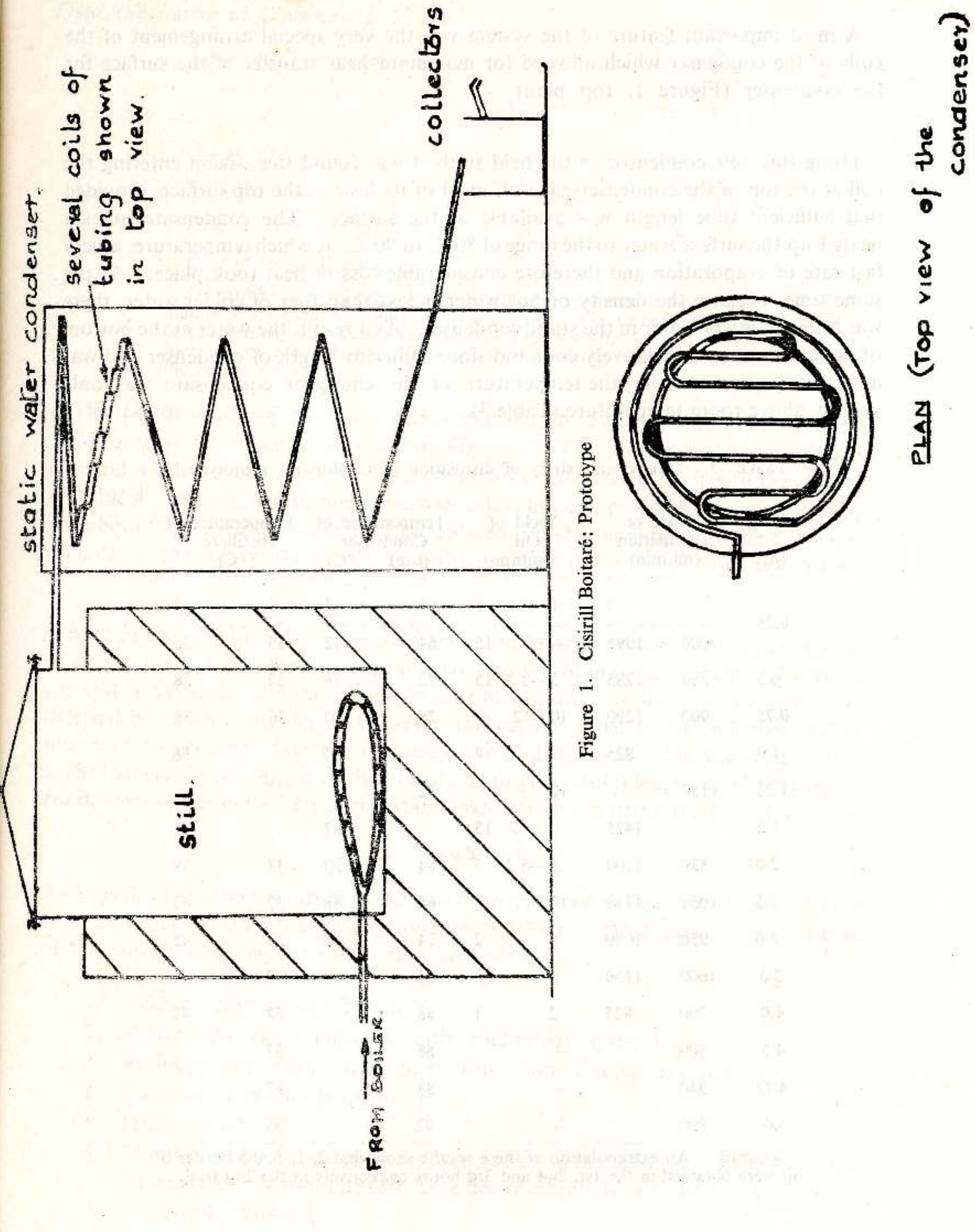

Figure 1. Cisirill Boitaré: Prototype

A most important feature of the system was the very special arrangement of the coils of the condenser which allowed for maximum heat transfer at the surface for the condenser (Figure 1, top plan)

Using this new condensor in the field trials it was found that steam entering the coil at the top of the condenser gave off most of its heat at the top surface, provided that sufficient tube length was available at the surface. The condensate quickly heated up the surface water to the range of 80°C to 90°C, at which temperature, a very fast rate of evaporation and therefore considerable loss of heat took place. At the same time, because the density of hot water is less than that of colder water, there was little mixing of water in the static condenser. As a result, the water at the bottom of the condenser was relatively cool and since sufficient length of condenser coil was available for heat transfer, the temperature of the emergent condensate was only slightly above room temperature (Table 3).

TABLE 3. Time course study of distillation of C. Boitarél prototype

Time (h)	Rate of Distillation (ml/min)		Yield of Oil (ml/min)		Temperature of Condenser (top) (°C)		Temperature of Distillate (°C)	
	1	2	1	2	1	2	1	2
0.25	1000	1095	+	15	64	72	35	36
0.5	800	1285	5—8	15	72	76	32	38
0.75	900	1290	10—12	13	78	80	36	38
1.0		825		7		84		36
1.25	1150		12		82		37	
1.5		1425		15		87		41
2.0	830	1100	5—6	5	84	90	37	39
2.5	1050	1110	10	3	68	88	37	42
3.0	950	1080	8	2	74	88	37	45
3.5	1000	1150	3	+	85		37	44
4.0	700	825	2	1	88		37	42
4.5	500		+		88		37	
4.75	940		+		88		37	
5.0	890		+		92		39	

+, trace. An extrapolation of these results show that 2, 1, 5, 0·5 bottles of oil were obtained in the 1st, 2nd and 3rd hours respectively in the 2nd trial.

TABLE 4. The performance of CISIRILL Boitaré prototype

	Trial 1	Trial 2
Charge (lbs)	564	560
Yield (bottles)	4 (1.2%)	4 (1.2%)
Time of distillation (h)	5	4
Time of Initial Heating (h)	1	1

The still body was loaded with 7 bundles of cinnamon leaf (approximately 80 lbs each) and choking was avoided. The furnace was fired to a maximum using firewood for the first 1 to 1½ hours, so that a very high rate of distillation was achieved thereby putting the condenser to the stiffest possible test.

The performance of this still is summarised in Table 4, and a diagram of the prototype C. Boitarè[1] is shown in Figure 1. This still has been operating in Dodanduwa from December 1977 and continues to give results similar to those given in Table 4. The still can be operated twice a day, but one precaution has to be taken, viz, about 500 gallons of water must be replaced from the upper part of the condenser each day to prevent overheating, if the still has to be used for two or more distillations/day.

Studies with the prototype still have led to further refinements for the new system of distillation. It has been decided to maintain the Manakoka principle of keeping the still body, steam generator and furnace in one unit, as this is as effective as an external boiler and costs less. However, the vapour outlet of the still body will be increased to accommodate the increased rate of distillation. There will also be a slight increase in coil length of the prototype, to give a total length of 35 M, and the condenser coils as in the case of the Manakoka, will be constructed out of aluminium.

4. Conclusions

As a result of the incorporation of the new condenser, no overheating of the distillate was observed even at the high distillation rates of 1000 to 1200 ml/min. The advantage of the new system may be summarised as follows:

1. Efficient cooling of distillate.
2. Water sparing (compared with traditional system)
3. Reduced distillation time, permitting more distillations per day.
4. Lower cost of construction.
5. Higher yield.
6. Maintains advantages of Manakoka of having the still body-steam generator 2 furnace in one unit and also have better materials of construction than the traditional system.

Acknowledgements

The authors thank Mr. D. P. Wickremasinghe for allowing them to use his still and other facilities for testing the C. Boitaré condenser system, Mr. S. G. A. de Silva, Mr. Upali Ranatunge, the D. D. C., Karandeniya and Hayleys Ltd., for the use of their stills for field trials, other still owners for allowing them to visit their stills. Also the Director, CISIR, for facilities provided, Mr. M. M. N. de Silva and Mr. S. Santhiramouleeson for technical assistance, Miss K. D. Ratnayake for the drawings for this paper and Miss K. S. U. Perera and Mrs. Shirani Samaranayake for secretarial assistance.

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Oestrus Response and Pregnancy rate Following Prostaglandin and short term Progesterone Intravaginal Device Treatment in Buffaloes (*Bubalus bubalis*)

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Abstract : Eighteen cycling buffalo cows having functional corpora lutea were treated with a single intramuscular injection of 30 mg of prostaglandin $F_{2\alpha}$. The oestrus response and pregnancy rate following treatment were 16.6% and 11.1%, respectively. Sixteen randomly selected post partum cows were treated with a progesterone intravaginal device, for 12 days. 10 mg of oestradiol 17 β in 5 ml of ether was also injected at the time of insertion of the device. The retention rate under field conditions was 72% and 100% when housed. Seventy seven percent of the cows which retained the device for 12 days, returned to oestrus within 4 to 5 days after removal of the device. The pregnancy rate at 90 days after mating was 62%. The results indicate that short term progesterone intravaginal device treatment is more reliable than prostaglandin for synchronising oestrus in buffaloes.

1. Introduction

Prostaglandins and short term progesterone intravaginal device treatments are both effective in synchronising oestrus in cattle. Fixed time inseminations after either or these treatments result in normal fertility.[2,9,11] These results suggest that the above treatments can be used to synchronise or induce oestrus in Asian water buffaloes (*Bubalus bubalis*), where oestrus detection is often difficult due to poor manifestation of external signs of oestrus. Limited research studies on the efficacy of prostaglandin and its analogues in buffaloes have shown that a single injection given between day 5 and 14 of the cycle or the double injection regime given 11 or 12 days apart, irrespective of the stage of cycle, are effective in synchronising or inducing oestrus. However, the fertility rates following natural service or fixed time inseminations at induced oestrus were only about 33%.[4,5,7] The use of short term progesterone intravaginal device treatment for synchronising or induction of oestrus in buffaloes has hitherto not been investigated.

The purpose of this study was to determine whether single intramuscular injection of prostaglandin $F_{2\alpha}$ and short term progesterone intravaginal device treatments were as effective in inducing oestrus in buffaloes as in cattle and to examine pregnancy rates by natural service at induced oestrus.

2. Experimental

Experiments were conducted at the National Livestock Development Board Farm, Ragedera, Malsiripura, in the Kurunegala District. Two hundred females and 11 males, pure Surti buffaloes imported from India in two batches in May 1976 and July 1977, are maintained in this farm. There is adequate green pasture/fodder of improved varieties for feeding and grazing. Milking animals are fed with a concentrate ration made of 35% coconut poonac and 65% rice bran along with mineral mixture. Adequate water is available for wallowing and drinking. The method of breeding is by observation for oestrus symptoms such as swelling of the vulva, vaginal discharges, etc, by an experienced farm Superintendent. Regularly bulls are taken round the females, morning and evening, to aid in heat detection. Females that are in oestrus are detained and served by these bulls. A wooden travice is used to facilitate stud services. Initially rectal examination of 65 buffalo cows were performed randomly to determine their cyclical state and pregnancy status. Based on this, 34 animals were selected for this study.

2.1. Experiment 1.

Eighteen non pregnant buffalo cows with palpable corpora lutea in their ovaries were selected. All animals were treated intramuscularly with a single injection of 30 mg of prostaglandin $F_{2}\alpha$ (Upjohn, U.S.A.). All treated cows were housed and observed continuously over a period of 5 days for signs of oestrus. Different bulls were taken round these cows thrice a day, also two bulls at a time sometimes, to provoke jealousy. The flehmen, mounting, vaginal discharges, etc, were noted. If a bull showed sexual excitement after flehmen, the cows were taken to the travice and served naturally. Rectal palpations were done 90 days after mating to determine the pregnancy.

2.2. Experiment 2.

The study involved 16 non pregnant buffalo cows randomly selected without reference to their ovarian activity. A 6.75% progesterone impregnated Silastic intravaginal device (Abbott Laboratories) was inserted into the vagina with a help of a plastic speculum and a plunger lubricated with hibitane cream (ICI). The external genitalia was scrubbed and a disinfectant was applied before inserting the device. Ten mg of oestradiol 17 β in 5 ml of ether was also injected at the time of insertion of the device to cause early luteal regression. The devices were left in place for 12 days and were removed by pulling the string attached to the device which was left protruding from the vulva. All cows were sent for free grazing and wallowing after insertion of the device except for 5 cows which had to be housed due to management problems. The cows were observed for signs of oestrus during the treatment period and after removal of the device. The heat detection procedure was similar to experiment 1. All cows which showed external signs of oestrus and receptivity to the bull were naturally served at the induced oestrus. Rectal palpations were done 90 days after mating to determine the pregnancy.

3. Results

3.1. Experiment 1.

The results are summarised in Table 1. Of the treated animals only 16.6% showed receptivity to the males. The vaginal discharges were scanty or none at all. The mean interval to oestrus after prostaglandin injection was 54 hours. A lack of interest was shown by the bulls to mount the rest of the cows. Pregnancy rate was 11.1%.

TABLE 1. The incidence of oestrus and pregnancy rate following single intramuscular injection of 30 mg of prostaglandin $F_{2\alpha}$ in buffaloes

No. of animals treated ...	18
No. exhibited oestrus	3
Mean interval to oestrus in hours	54
No. diagnosed pregnant at 90 days	2

3.2. Experiment 2.

The results are summarised in Table 2. None of the cows showed signs of oestrus while the device was in place. The overall retention rate of the device was 81%. Seventy three percent of the cows which were sent for free grazing and wallowing retained the device while all animals that were housed, retained. Seventy seven percent of the cows which retained the device for 12 days returned to oestrus between the 4th and 5th day after removal of the device with a mean interval to oestrus of 102 ± 10 hours. The fertility rate based on pregnancy diagnosis by rectal palpation 90 days after mating were 62%.

TABLE 2. Retention rate, incidence of oestrus and pregnancy rate following progesterone intravaginal treatment in buffaloes

No. of animals treated	16
Proportion retaining device (%) ...	81.2
Proportion showing oestrus signs (%)	
(*a*) Overall	62.5
(*b*) Among those retaining device ...	77.0
Mean interval to oestrus (hours) ...	102 ± 10
Pregnancy at 90 days (%)	
(*a*) Overall	50.0
(*b*) Among those retaining device ...	62.0
(*c*) Among those served	80.0

4. Discussion

The results of this study indicate that the oestrus response following single intramuscular injection of prostaglandin $F_{2\alpha}$ was very poor contrary to that reported by Jainudeen.[4] It was reported by many workers that the single injection of prostaglandin $F_2\alpha$ could be used successfully to synchronise oestrus in dairy and beef cattle, with adequate heat detection programmes[6] and also to induce fertile oestrus in cattle.[3] However, Cooper[1] has pointed out in his experiments that synchronisation of oestrus after the second injection of prostaglandin $F_{2\alpha}$ was more precise than after the first or single injection. This has some important practical implications especially in buffaloes, since oestrus symptoms under normal physiological conditions are very vague, short or irregular. If this appears to be so, as indicative from this study, the strategic double dose prostaglandin treatment regime will be more practical for use in buffaloes[7] for effective oestrus synchronisation programmes than the single injection.

The fertility rate following single intramuscular injection of prostaglandin $F_{2\alpha}$ was also very poor and only 11.1 %. However, Jainudeen[4,5] and Perera *et al*[7] reported a fertility rate of 33 % following single and double injection regime, with natural service and fixed time inseminations at induced oestrus. The low fertility observed with prostaglandin treatments in buffaloes warrant further investigation, to elucidate the constraints, to obtain high fertility rate in this species.

The retention rate observed in the present study following short term progesterone intravaginal device treatment is comparable to results reported in cattle.[8,10] The device caused hardly any irritation to the vaginal wall as judged by the rectal palpation at the end of treatment, although in many cases a milky discharge was observed during the treatment period and after removal. In this study the oestrus response observed following short term progesterone treatment was 77%. This observation is in agreement with that reported for cattle.[9,11] Bulls showed a better response in mounting females after progesterone treatment than with cows treated with prostaglandins. A similar situation was also observed in goats, where the male goats showed a lack of interest to mount prostaglandin induced oestrus females.[9]

The mean interval to oestrus, after removal of the device was 102 ± 10 hours. This observation is in contrast to that observed in cattle, where most of the animals returned to oestrus by 48 hours after removal of the device.[8,10] However, the low variability in the period to oestrus after removal of the device, indicates that artificial insemination is feasible at pre-determined time without the need to detect oestrus.

The fertility rate observed after progesterone intravaginal device treatment was much higher than the normal calving rate for post partum buffalo cows in the farm, where it was found to be around 32%. Further, the fertility rate obtained is better than observed after prostaglandin treatment in buffaloes[4,5,7] and comparable to that reported for cattle.[9,10].

In conclusion, the results of this study indicate that the 12 day progesterone intravaginal device treatment is more effective in inducing fertile oestrus in post partum buffalo cows. This synchronisation treatment is more applicable under field conditions than prostaglandin as the need for prior examination to determine the stage of cycle does not arise. Further work on large number of cows and heifers is being carried out to evaluate the retention rate under free grazing and wallowing, and to determine fertility rate following fixed time inseminations without reference to oestrus.

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The Alternating Copolymerization of n-Butyl Vinyl Ether with Maleic Anhydride

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Abstract : n-Butyl vinyl ether (BVE) and maleic anhydride (MA) copolymerized in chloroform with a radical initiator to give 1 : 1 alternating copolymer. The initial rate of copolymerization was maximum at 1 : 1 feed composition and the limiting conversion was close to the theoretical limiting conversion. The charge-transfer (CT) complex of BVE and MA showed a UV absorption maximum at 270 nm in 1, 2-dichloroethane. The stoichiometry of the complex was 1 : 1. The equilibrium constants of the complexation were found to be 0.37 dm^3/mol in carbon tetrachloride at 37°C by NMR, and 0.27 dm^3/mol in chloroform and 0.11 dm^3/mol in 1, 2-dichloroethane both by UV at 23°C. The participation of the CT complex of BVE and MA into their alternating copolymerization was discussed.

1. Introduction

It has been known that polar monomers which do not homopolymerize individually, could be copolymerized with radical initiators to give alternating copolymers when the polarities of the comonomers are opposite and large.[11,14,18] Participation of the charge-transfer (CT) complex formed between the comonomers, has been proposed for the alternating copolymerizations of some vinyl ethers such as 2-chloroethyl vinyl ether,[9] p-dioxene,[6] 1, 2-dimethoxyethylene,[10] ethyl vinyl ether[3] and dihydropryran[3] with maleic anhydride (MA), which has a strongly positively polarized C=C double bond (Alfrey-Price $e = 2.25$ and $Q = 0.23$).[4] The mechanism suggested is that the CT complex formed between the comonomers is the species that polymerizes to give an alternating copolymer.[9]

In this paper, the CT complexation of n-butyl vinyl ether (BVE) (Alfrey-Price $e = -1.20$ and $Q = 0.087$)[4] and MA is studied in chloroalkanes to explain the radical copolymerization of BVE with MA.

2. Experimental

2.1. Materials

Reagent grade MA (British Drug House) was recrystallized from benzene, reagent grade BVE (B.D.H.) was fractionally distilled and reagent grade 2, 2'-azobisisobutylonitrile (AIBN) (Tokyo Kasei) was recrystallized from methanol before use. All solvents were purified by the usual methods.[17]

2.2. Spectroscopy

The ultraviolet (UV) spectra of the CT complex were taken by using a UNICAM SP8—100 spectrophotometer with quartz cells of 1 cm path length. The nuclear magnetic resonance (NMR) spectra were taken by a Varian EM-360 60 MNz NMR spectrophotometer at 37°C. JASCO J-0001 infra-red (IR) spectrophotometer was used to take the IR spectra of the copolymer from KBr pellets.

2.3. Polymerization

The copolymerizations were carried out in chloroform solutions with AIBN as the radical initiator in glass ampules of approximately 15 cm^3 capacity, which were sealed after degassing by the freeze-thaw method on a vacuum line. The sealed ampules were then immersed in an oil bath at 60° ± 0.1°C. The polymerizations were stopped at the end of the reaction periods by immediately pouring the reaction mixtures in large amounts of diethyl ether, in which the polymers were precipitated out. The polymers were purified by reprecipitation from the acetone solutions in diethyl ether. The rate of the polymerization was measured gravimetrically.

The compositions of the copolymers were determined by conductometrically titrating the MA units with Philips PR9500 conductivity bridge. The copolymers were dissolved in water with 0.1 M NaOH and back-titrated with 0.1 M HCl.

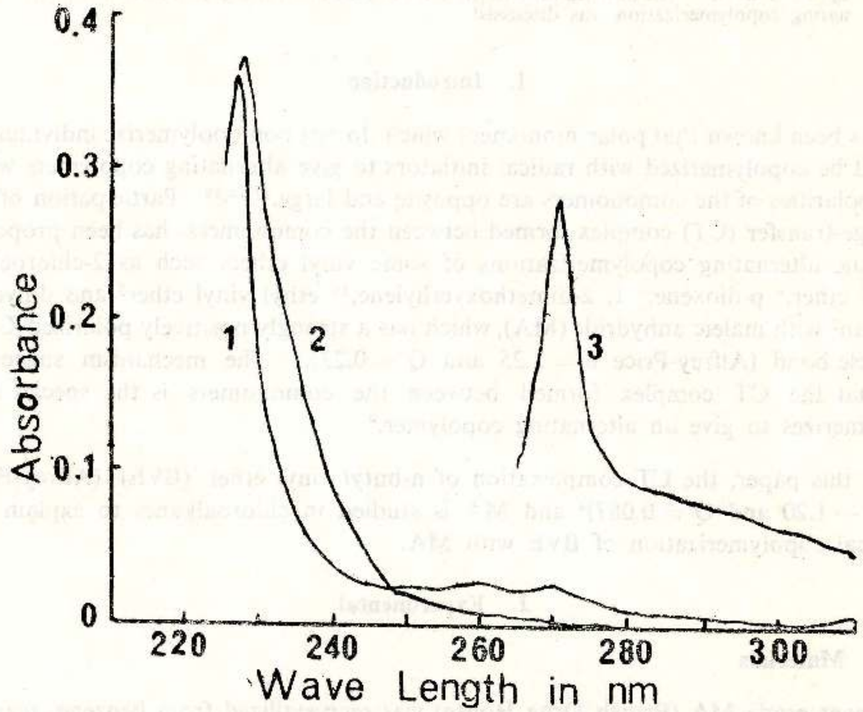

Figure 1. The UV absorption of BVE-MA charge-transfer complex in CH_2ClCH_2Cl at 23°C.
(1) [BVE] = 6.25 × 10^{-3} mole/dm^3 v.s. solvent
(2) [MA] = 1.01 × 10^{-4} mole/dm^3 v.s. solvent.
(3) Charge-transfer complex only, [BVE] = 1.20 M and [MA] = 1.02 × 10^{-4} mole/dm^3.

3. Results and Discussion

3.1. The charge-transfer complexation between n-butyl vinyl ether and maleic anhydride

An enhancement of absorption is observed in the UV region when BVE and MA are mixed in 1, 2-dichloroethane. When the absorptions of BVE and MA are subtracted from the overall absorption, the enhancement becomes an absorption maximum at 270 nm as shown in Figure 1. This new absorption maximum is attributed to a weak CT complexation between BVE and MA, BVE acting as the electron donor and MA as the acceptor, considering the polarities of the compounds.

The stoichiometry of the complexation was determined in 1, 2-dichloroethane by the Job's continuous variation method.[7] As shown in Figure 2, the maximum of the absorbance-composition plot indicates that BVE and MA form a 1 : 1 CT complex.

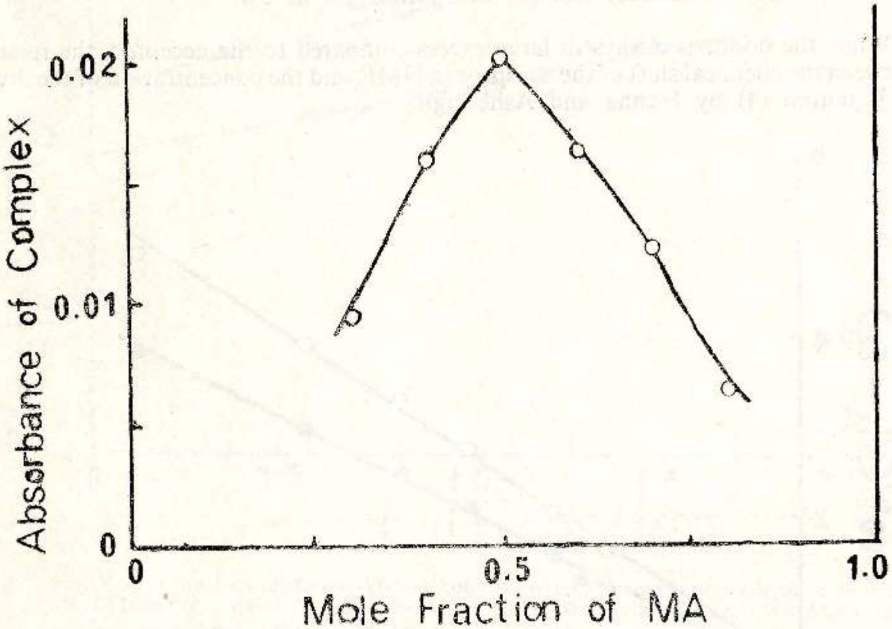

Figure 2. UV determination of the stoichiometry of the charge-transfer complex of BVE and MA by Job's continuous variation method in CH_2ClCH_2Cl at 328 nm. [BVE] + [MA] = 0.0610 mole/dm.^{3}

The equilibrium constant (K) of the CT complexation can be determined by UV and NMR spectroscopy. In the case of a 1 : 1 complexation, the relation between the absorptivity of the complex and the concentrations of the components has been derived by Ketelaar *et al.*[8]

$$1/(\epsilon_A - \epsilon_a) = 1/K\,(\epsilon_c - \epsilon_a)\,[D] + 1/(\epsilon_c - \epsilon_a) \qquad (1)$$

where [D] is the concentration of the donor and EA is related to the measured optical density, dA, and to the total molar concentration of both free and complexed acceptor [A] by the expression $d_A = \log_{10} I_0/I = E_A\,[A]l$. Ec and Ea represent, respectively, the extinction coefficients of the complexed and uncomplexed acceptor.

When a very small concentration of an acceptor and a large excess concentration of a donor are used, it can be assumed that all the acceptor is complexed. Under this condition, K can be determined through either the equation by Bensi and Hildebrand[1] (Equation (2)), or the equation by Scott[16] (Equation (3)).

$$[A]l/d_c = 1/\epsilon_c\,K[D] + 1/\epsilon_c \qquad (2)$$

$$[A]\,[D]l/d_c = [D]/\epsilon_c + 1/\epsilon_c K \qquad (3)$$

where, $[A] << [D]$, d_c is the absorbance due to the complex only, i.e., d_c = d(overall) —d (donor) and l is the pathlength in cm.

When the donor is always in large excess compared to the acceptor, the relation between the chemical shift of the acceptor in NMR and the concentration of the donor is Equation (4) by Hanna and Ashbough.[5]

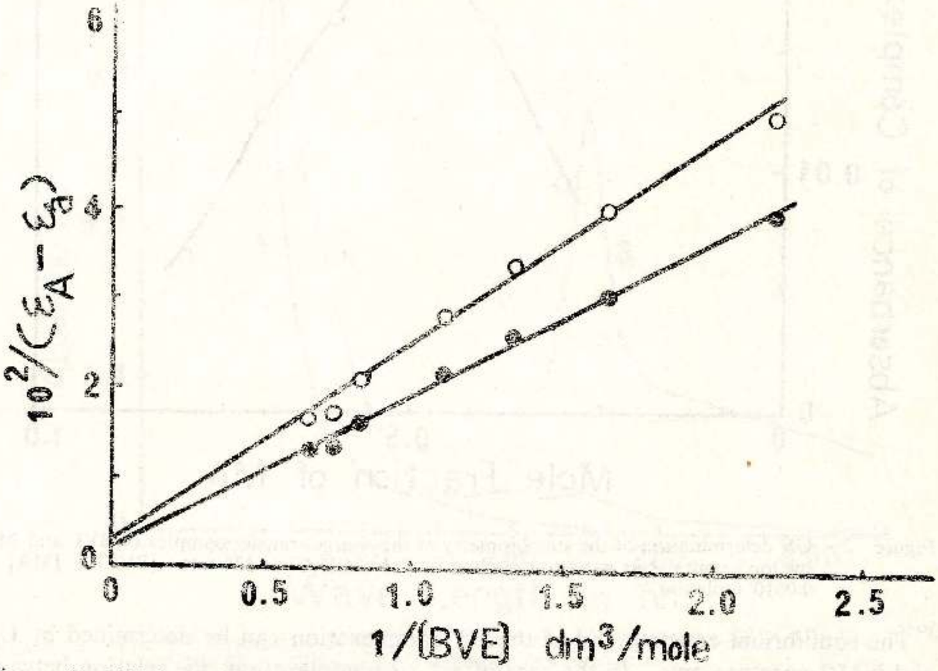

Figure 3. UV determination of the equilibrium constant of charge-transfer complexation between BVE and MA in CH_2ClCH_2Cl at 23°C by the method of Ketelaar *et al.* (Equation (1)). $[MA] = 4.12 \times 10^{-3}$ mole/dm³. (●) at 285 nm, (O) at 300 nm.

$$1/\Delta^A_{obs} = 1/K\Delta^A_c[D] + 1/\Delta^A_c \qquad (4)$$

where, $\Delta^A_{obs} = \delta^A_{obs} - \delta^A_o$ is the difference between the chemical shifts of the acceptor proton in complexing media ($\delta_{A obs}$) and that of the acceptor in uncomplexed form (δ^A_o), and $\Delta^A_c = \delta^A_c - \delta^A_o$ is the difference in the acceptor proton chemical shifts in pure complex (δ^A_c) and free acceptor.

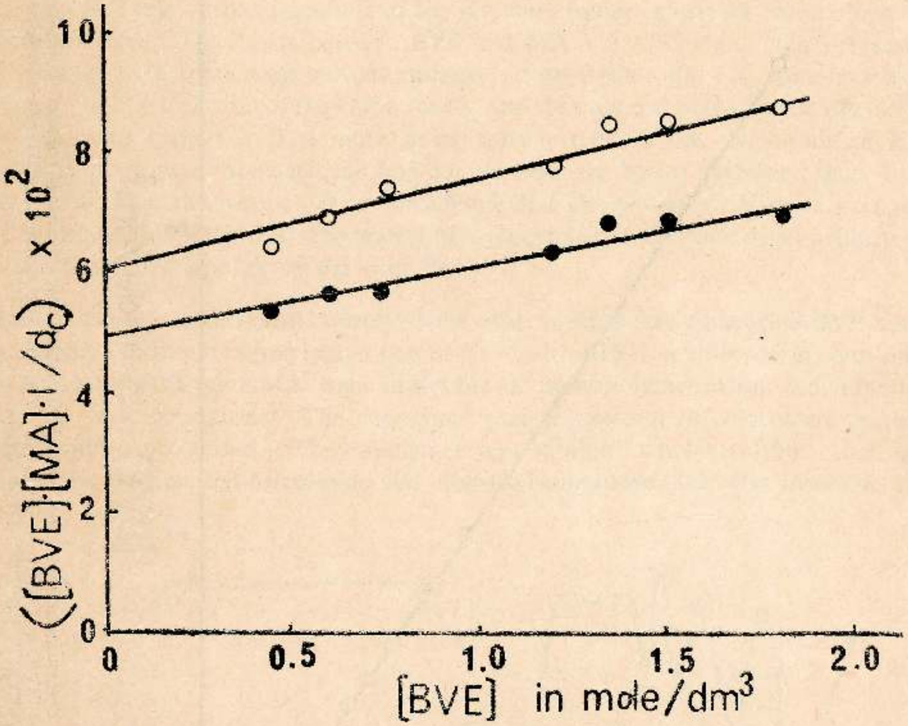

Figure 4. UV determination of the equilibrium constant of charge-transfer complexation between BVE and MA in $CHCl_4$ at 23°C by the method of Scott (Equation (3)). $[MA] = 4.12 \times 10^{-3}$ mole/dm^3. (●) at 285 nm, (O) at 300 nm.

The equilibrium constants of the CT complexation between BVE and MA were determined in 1, 2-dichloroethane by equation (1), in chloroform by Equation (3), and in carbon tetrachloride by Equation (4). The results are shown in Figs. 3, 4 and 5, respectively. In all cases, the concentration of MA was kept small and constant, while the concentration of BVE was increased. The chemical shift of chloroform was used as the inner standard in measuring the chemical shift of MA.

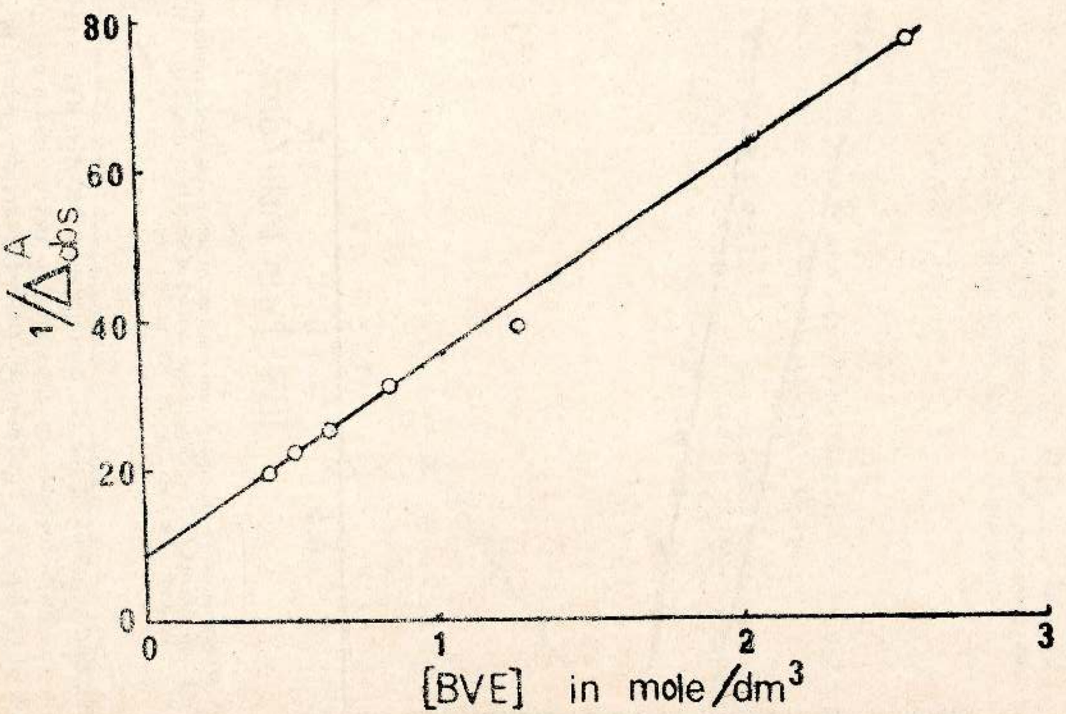

Figure 5. NMR determination of the equilibrium constant of charge-transfer complexation between BVE and MA in CCl_4 at 37°C by the method of Hanna and Ashbough (4)). [MA] = 1.00 × 10^{-2} mole/dm^3

TABLE 1. Relation between the polarity of the solvents and the equilibrium constants (K) of — charge-transfer complexation between BVE and MA in chloroalkanes.

Solvent	Dielectric constant[15]	Method	K (dm^3/mole)	εc or δAc
CCl_4	2.238 (20°C)	NMR at 37°C	0.37	6.988 ppm
$CHCl_3$	4.806 (20°C)	UV at 23°C	0.27 (at 285 nm) 0.26 (at 300 nm)	75 67
CH_2ClCH_2Cl	10.36 (25°C)	UV at 23°C	0.11 at (285 nm) 0.11 (at 300 nm)	560 450

As seen in Table 1, the magnitude of the K values found in various chloroalkanes indicate that the CT complex between BVE and MA is a weak one. The decrease of K values with increasing solvent polarity suggests that the CT complexation follows a polar association of the components, and that the complex is predominantly at its no-bond state.[12,13] The more polar solvent reduces the magnitude of K, because in more polar solvents, the free components are better stabilized than the complex of the components. It is considered that the planar vinyl ether part of BVE molecule complexes with the planar MA molecule parallel each other achieving the maximum overlapping of the orbitals.[12,13]

Radical copolymerization of n-butyl vinyl ether with maleic anhydride BVE and MA readily underwent copolymerization at 60°C with AIBN in chloroform solution, although both BVE and MA were incapable of homopolymerization individually under the same conditions. The copolymer precipitated out in chloroform as the polymerization proceeded. The copolymer was soluble in polar solvents such as acetone, N, N-dimethyl formamide and dimethylsulphoxide, but was insoluble in non-polar solvents.

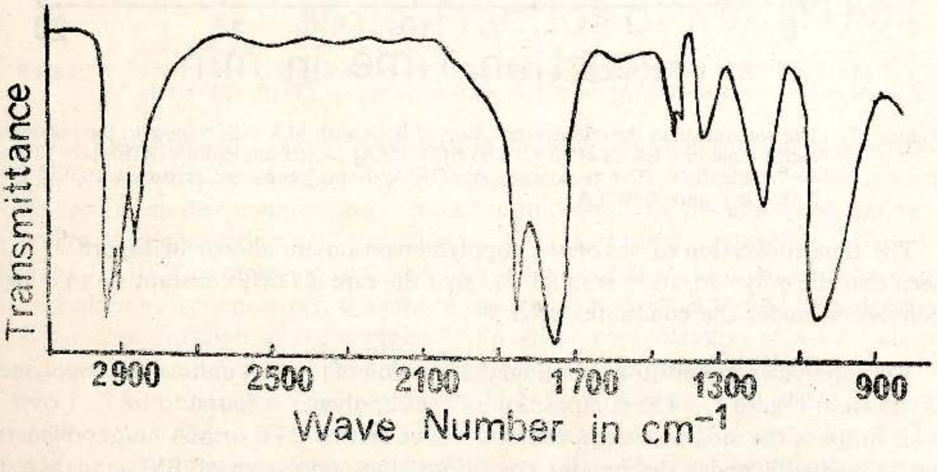

Figure 6. The IR absorption spectrum of the copolymer of BVE and MA. The mole fraction of the MA units in this copolymer is 0.49.

The IR spectrum of the copolymer in Fig. 6 shows large absorptions of five-membered anhydride group at 1770 and 1860 cm^{-1}. The absorption due to the unsaturated ether linkage CH$_2$=CH—O—C of BVE monomer which appears at 1220 cm^{-1} is shifted to 1080 cm^{-1} in the copolymer, showing that the ether linkage in the copolymer is saturated, —CH$_2$—CH—O—C. The sp^3 C—H stretching of BVE appears at 2860 and 2940 cm^{-1} both in the monomer and the copolymer. The sp^2 C—H stretching of BVE monomer at 3100 and 3040 cm^{-1} and that of MA at 3160 cm^{-1} are completely absent in the copolymer, indicating the consumption of C=C double bonds in the copolymerization.

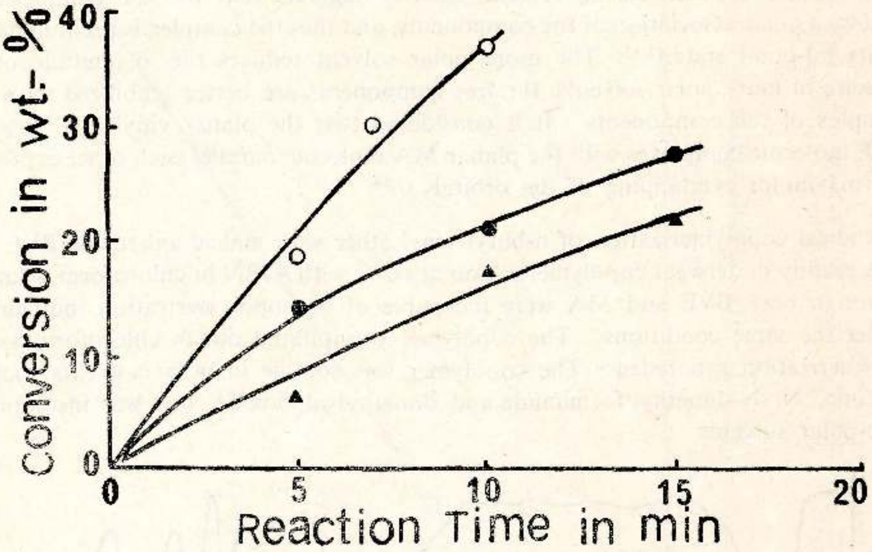

Figure 7. The conversion in the copolymerization of BVE with MA with respect to the polymerization time in CHCL$_3$ at 60°C. [BVE] + [MA] = 1.50 mole/dm^3, [AIBN] = 3.00 × 10^{-2} mole/dm^3. The mole fraction of MA in the monomer mixture was 0.50 (O), 0.65 (●) and 0.80 (▲).

The time-conversion curves of the copolymerization are shown in Figure 7. It is seen that the polymerization is rapid and that the rate is fairly constant up to a high conversion under the conditions used.

The copolymer composition based on the titration of the MA units of the copolymer is shown in Figure 8. The composition of the copolymer is found to be 1 : 1 over a wide range of the monomer composition. Since neither BVE or MA homopolymerizes individually under the present conditions, the copolymer of BVE and MA is considered to be a 1 : 1 alternating copolymer.

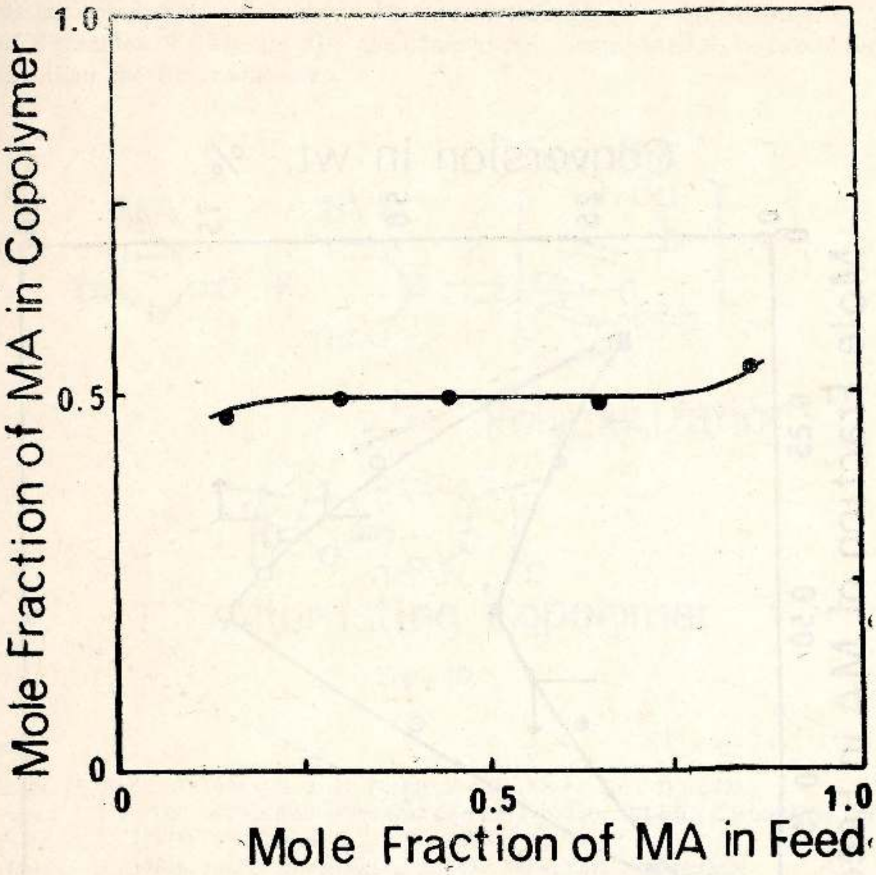

Figure 8. The copolymer composition curve for the copolymerization of BVE with MA in $CHCl_3$ at 60°C. [BVE] + [MA] = 3.00 mole/dm^3, [AIBN] = 6.00 × 10^{-} mole/dm^3.

The initial rate of the copolymerization and the conversion of the polymerization after a prolonged reaction period (24 hours), are shown in Figure 9, with respect to the feed monomer composition. Both the initial rate of the copolymerization and the limiting conversion are maximum at 1 : 1 monomer composition of the feed. If the 1 : 1 CT complex of BVE and MA is the species that polymerizes to give the 1 : 1 alternating copolymer, the rate of the copolymerization should be proportional to the concentration of the complex.[2] Since the concentration of a 1 : 1 complex becomes maximum at 1 : 1 feed monomer composition, the rate should be maximum at 1 : 1 feed monomer composition, which is consistent with the experimental observation. The theoretical limiting conversion is calculated assuming the polymerization is an alternating copolymerization. The observed limiting conversion is within the theoretical limiting conversion and is closely parallel to it.

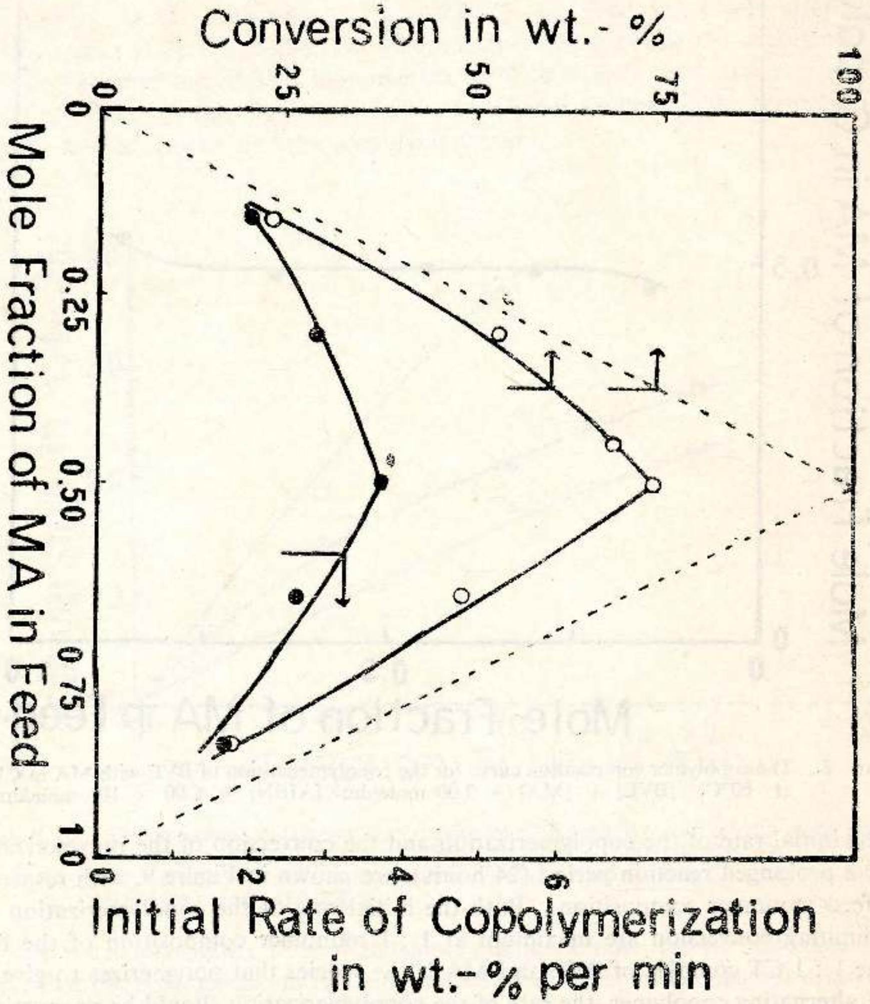

Figure 9. The initial rate of copolymerization of BVE with MA (●), and the limiting conversion after 24 hours of polymerization (O). The dotted lines are calculated for the maximum possible conversion for a pure alternating copolymerization. (BVE) + (MA) = 1.50 mole/dm³, (AIBN) = 3.00×10^{-2} mole/dm³ in $CHCl_3$ at 60°C.

Thus the copolymerization of BVE with MA can be explained when the 1 : 1 alternating copolymer is thought to be formed through the polymerization of the 1 : 1 CT complex of BVE and MA, the complex being considered to be much more reactive than the free monomers.

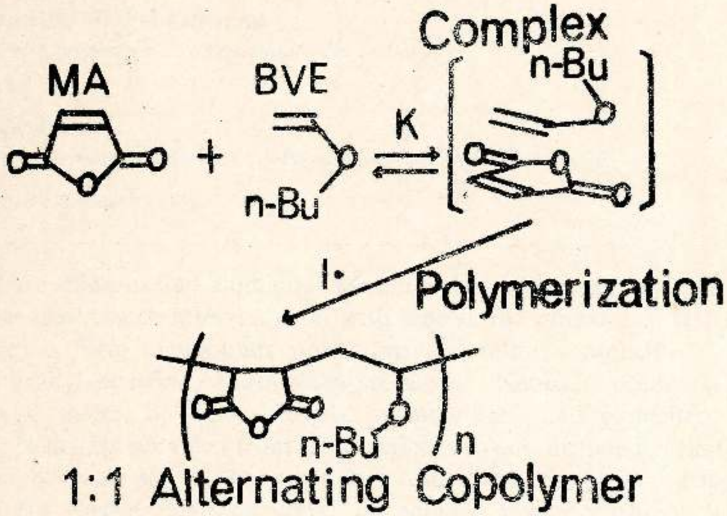

Fig. 10.

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SHORT COMMUNICATION

Some Studies on Pozzolanic Cement

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Pozzolans[1] are siliceous and aluminous mineral substances which, though having no cementitious qualities themselves, react with lime in the presence of water at room temperature to form compounds possessing cementitious properties. Pozzolans may be naturally occurring or artificially produced. Naturally occurring pozzolans include clays, shales, opaline materials, volcanic tuffs and pumicites. Artificial pozzolans are mainly obtained from industrial wastes and include fly ash (flue dust), silica fume and some slags. The pozzolans available in Sri Lanka include broken bricks, broken wasted tiles and clays. A detailed review of pozzolanic cements their manufacture and use in India, has recently been published.

Pozzolanic cement is obtained when pozzolans are finely ground with Portland cement. Some advantages of pozzolanic cements over Portland cement are that they are cheaper, they have improved plasticity and they have higher resistance to sulphate attack.

Pozzolanic activity is believed[3] to be due to the siliceous compounds in pozzolan reacting with the calcium hydroxide formed during the hydration of cement to form stable cementitious substances involving calcium, silica and water.

Our objective was to study the effect of readily available and cheap pozzolanic materials found in Sri Lanka on the properties of Kankesan Portland cement. Burnt clay (from the clay yard at Kankesanturai ; Murunkan clay) and tile powder (powdered broken roof tiles—an industrial waste) were used. The conditions under which these pozzolans exhibit maximum activity were first found out. The pozzolans were then ground with cement, in various proportions, and various properties (tensile strength, compressive strength, sulphate resistivity, initial setting time, final setting time, consistency, workability) were studied so as to evaluate the quality of the pozzolanic cement obtained.

Various tests[4] have been devised to estimate pozzolanic activity. From the definition of pozzolans, it is clear that the most useful test is chemical reactivity with lime.

To find out the rconditions under which pozzolans exhibit maximum activity chemical reactivities with lime and alkali were investigated.

Clay samples were dried, jaw crushed and ball milled. The clay powder obtained was burnt in a muffle furnace at different temperatures. At about 600°C, the clay changed from greenish black to bright red, above 1000°C it turned to dull red. The chemical composition of the clay used is given in Table I.

TABLE 1. Chemical analysis of clay

	% by weight
SiO_2	61.3
Al_2O_3	16.5
Fe_2O_3	6.7
Loss on Ignition	9.1
CaO	4.4
MgO	1.5
	99.5

Pozzolans, heated at different temperatures for various times, were finely powdered, sieved through 170 mesh sieve and reacted with a one molar solution of NaOH. The percentage reduction in alkalinity under standard conditions (when 100g of solid is added to 1000 ml of 1M NaOH) was found by titrating with a standard HCl solution. The results for clay and tile are given in Tables 2 and 3 respectively.

TABLE 2. Murunkan Clay : % reduction in alkalinity as a function of temperature and time of "calcination"

Temp. of "calcination" °C	1 hour	4 hours	1 day	4 days	6 days	10 days	20 days
300	0.98	1.26	1.42	1.87	2.04	2.23	2.43
600	1.26	1.76	1.20	2.06	2.45	2.65	2.72
800	1.28	1.74	1.79	2.04	2.50	2.64	2.71
1000	0.65	0.70	0.76	1.23	1.45	1.37	2.01
1200	0.52	0.56	0.62	0.62	0.65	0.64	0.12

TABLE 3. Tile Powder : % Reduction in alkalinity

Temp. of "calcination" °C	1 hour	4 hours	4 days	6 days	10 days	20 days	40 days
Room temp. (no heating)	1.32	1.87	2.23	2.85	3.28	4.63	4.62
600	1.20	1.97	2.03	2.53	3.23	4.57	4.57
1000	0.57	1.29	—	1.63	1.64	1.72	1.83
1200	0.52	0.68	0.73	0.74	0.74	0.74	0.74

The results show that percentage reduction in alkalinity, and therefore pozzolanic activity, is maximum when the temperature of calcination of clay is between 600°C and 800°C. For roof tiles, there was no increase in pozzolanic activity on heating. This is understandable in view of the fact that heat pretreatment had already been given during the manufacture of roof tiles. The results also show that the pozzolanic activity of powdered roof tiles is better than that of clay.

By a detailed study of various types of clays, Indian workers have shown[5] that maximum pozzolanic activity is exhibited when the temperature of heating is close to the temperature at which there is collapse of the lattice structure of the clay. Pozzolanic activity would therefore depend on the type of clay and also on the nature and amount of impurities present. The decrease in pozzolanic activity observed (see Tables 2 and 4) when clay samples are heated to higher temperatures has been explained[5] as due to increase in particle size, improvement in crystallinity and the formation and growth of crystals.

TABLE 4. % Lime reacted with clay powder (total lime—free lime)

Temp. of "calcination" °C	1 hour	2 days	7 days	10 days	20 days
300	52.5	53.5	58.8	58.9	58.9
600	58.2	60.3	63.5	68.8	69.3
1000	53.0	56.7	59.3	62.3	64.5

The pozzolan was mixed with calcium oxide and made into a paste by adding water. The amount of lime reacted was determined, using standard procedures, by finding the total lime content and the "free lime" content. The total lime content was determined by converting it to calcium oxalate and titrating with $KMnO_4$. The "free lime" was determined by adding ethylene glycol and titrating with dilute HCl using bromo-cresol as indicator.

The results in Table 4 indicate that pozzolanic activity of clay is optimum when samples were preheated to a temperature of about 600°C. For tile powder (Table 5) preheating did not improve pozzolanic behaviour.

TABLE 5. % of Lime reacted with tile powder

Temp. of "calcination" °C	1 hour	1 day	2 days	7 days	28 days
Room temp. (No heating)	51.26	66.8	72.3	81.3	85.3
600	50.0	66.5	—	80.2	84.4
1000	64.3	—	67.8	79.8	82.2

Tile powder was used for the preparation of pozzolanic cement. The advantage over clay is that no preheating is necessary.

Two methods of preparing pozzolanic cements from tile powder were attempted : (*a*) by grinding portland cement with tile powder (*b*) by "straight grinding" of clinker chips, tile chips and gypsum chips.

To prepare pozzolanic cement by method (*a*), broken tiles were ball milled for about 4 hours in a sample mill, sieved through 170 mesh sieve, mixed with Portland cement, ball milled again for half an hour for proper mixing and then sieved again through 72 mesh.

Difficulties were encountered in the preparation of pozzolanic cement by grinding clinker chips, tile chips and gypsum chips in an one-chambered tube mill. Grinding was not uniform because the grindability indices of cement and tile were different. Furthermore, the fine particles formed had a cushioning effect thereby hindering further grinding. This difficulty may not arise if a three-chambered mill is used.

Various physical properties were studied to evaluate the quality of the pozzolanic cement produced by grinding cement with tile powder.

Cement briquettes were made by hand tampering; water : cement ratio used was 0.3. The briquettes were removed after 24 hours, immersed in water for a number of days, dried for half an hour and tested. The storage water was changed every seven days.

TABLE 6. Tensile Strength (lbs/sq. in.)

Time	3 days	7 days	28 days	2 months	1 year
Portland cement	—	590	710	735	780
Pozzolan cement 20 : 80 (i.e. 20% tile powder + 80% portland cement)	—	525	700	750	800
Pozzolan cement 30 : 70 (i.e. 30% tile powder + 70% Portland cement)	—	495	685	745	825
Portland cement : Sand — 1 : 3	235	330	400	—	—
Pozzolan (40 : 60) : Sand — 1 : 3	230	270	450	—	—
Pozzolan (50 : 50) : Sand — 1 : 3	200	270	410	—	—

Some of the results of tensile strength measurements are given in Table 6. The table also gives (in the last two rows) some results of initial tensile strength measurements of pozzolanic cement : sand (in the ratio 1 : 3) mixes (water : cement ratio = 0.6.).

The results show that the tensile strengths of pozzolanic cements are comparable with those of Portland cement. There are no ASTM specifications for the tensile strengths of pozzolanic cements.

Cubes of side 2.78 inches were made using a vibration machine according to ASTM procedures.[6] Cement : sand ratio used was 1 : 3. Sand was sieved between 18 mesh and 25 mesh. Water : cement ratio was 0.6. The cubes were removed from the moulds after 24 hours and kept immersed in water for several days. After drying for half an hour, compressive strengths were measured. Some of the results obtained are given in Table 7.

TABLE 7. Compressive Strength (lbs/sq. in.)

Time	3 days	7 days	28 days	3 months
Portland cement	—	4480	5230	5590
Pozzolanic cement (20 : 80)	—	3370	4620	5130
Pozzolanic cement (30 : 70)	—	3190	4230	5070
Pozzolanic cement* (40 : 60)	2025	2600	3050	—
Pozzolanic cement* (50 : 50)	1150	2050	3050	—

*Cubes were made by hand tampering.

The results show that our pozzolanic cements have lower compressive strengths than those of Portland cement. The strengths are, however, satisfactory ; they conform to ASTM specifications[6] for pozzolanic cements according to which compressive strengths for Type I and Type II cements after 28 days should be above 3000 lbs/sq.inch. and 2500 lbs/sq.inch respectively.

Briquettes cast with portland cement and pozzolanic cement (30 : 70) were kept in 10% $MgSO_4$ solutions, 10% Na_2SO_4, solutions and in sea water for more than a year for visual observation. It was observed that pozzolanic cement was more stable to sulphate attack than Portland cement.

Some of the other relevant properties of the pozzolanic cements prepared were also tested. The results obtained of the normal consistency, the initial setting time and the final setting time are indicated in Table 8, together with the ASTM specifications.[6] It is seen that all the results conform to the ASTM specifications.

TABLE 8. Normal consistency and setting times of the pozzolanic cements prepared compared with ASTM specifications.

	40% tile powder 60% cement	50% tile powder 50% cement	ASTM specification
Normal consistency	35%	37%	64% (maximum)
Initial setting time	79 minutes	85 minutes	60 minutes (maximum)
Final setting time	145 minutes	155 minutes	10 hours (maximum)

The plasticity and workability, tested qualitatively by a hand trowel, of pozzolanic cement-water mixes also appeared to be better than that of portland cement.

In Sri Lanka, red cement is made by mixing 10 to 15% of red pigment (Fe_2O_3) with Portland cement. The pigment is costly. Visual observations showed that when 30% of tile powder (sieved through 170 mesh) is mixed with 70% cement, only about 3 to 5% pigment is needed to produce the same intensity of colour. Even without red pigment the colour of the pozzolanic cement is reasonably satisfactory. Red pozzolan Portland cement is cheaper than red cement and some of its properties such as water tightness, workability, sulphate resistivity are also found to be better.

Red pozzolan Portland cement could be used not only for flooring purposes but also as a colour wash. It sticks on the walls better than the normal colour washes without the addition of any starch or glues.

The results indicate clearly that good quality pozzolanic cements conforming to ASTM specifications[6] could be manufactured in Sri Lanka by grinding Portland cement with powdered roof tiles (40 to 50% by weight of tile powder). Pozzolanic cements are better than Portland cement for certain applications, and they are also cheaper.

An approximate cost analysis shows that pozzolanic cement will be about 25% cheaper than Portland cement. Broken tiles, constituting an industrial waste, are readily available at various places in Sri Lanka.

To manufacture pozzolanic cement the under-utilized grinding facilities presently available in Sri Lanka could be used. New machinery would not therefore be required.

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වික්‍රමසිංහ, ආර්. එල්., ඒකනායක, ඒ., රාජසිංහම්, සී. සී. සහ ද සිල්වා, එම්. ජයන්ති

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තේ නිෂ්පාදනය කරන සම්මත ක්‍රමය අනුව අධික වේලාවක් පැහෙන්නට ඉඩදීමෙන් වෙනත් තේ කොළ සෛල සංරචක සමහ බැඳීම හේතුකොටගෙන තේවල ඇති පොලිපීනෝල් රසායනික ද්‍රව්‍යයෙහි ද්‍රාව්‍යතාව අඩු වන්නේය; පැසවීමේ කාලය නිසා අඩංගු වී ඇති මුළු ඇමයිනෝ අම්ල ප්‍රමාණය කෙරෙහි බලපෑමක් ඇතිවන්නේ නැත. උණුකිරීමේදී බන්ධිත පොලිපීනෝල් මට්ටම සහ අඩංගුවී ඇති මුළු ඇමයිනෝ අම්ල ප්‍රමාණය වැඩිවන අතර වාෂ්පශීලී සංයෝග බොහෝදුරට අඩුවන බවද පෙනේ.

ගොයම් පිදුරු ක්ෂාර පිරියමට භාජනය කිරීම — ශක්තිය හා අප්‍රෝටීන නෛට්‍රජන් ප්‍රතිපූරණය කෙරෙහි බැටළුවන් විසින් පිදුරු ආහාරයට ගන්නා ප්‍රමාණය සහ දිරවීමේ හැකියාව බලපාන හැටි.

ජයසූරිය, එම්. සී. එන්.

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සෝඩියම් හයිඩ්‍රොක්සයිඩ් පිරියමට බඳුන් කළ පිදුරු දිරවිය හැකි ප්‍රමාණය සහ කැමැත්තෙන් ආහාරයට ගන්නා පදනම යටතේ ශක්තිය හා අප්‍රෝටීන නෛට්‍රජන් ප්‍රතිපූරණය කෙරෙහි ඇතිවන බලපෑම මැන බැලීමට දෙමුහුන් බැටළුවන්ට ඒ පිදුරු ආහාරයට දී කළ පරීක්ෂණයක තොරතුරු මේ ලිපියෙහි දක්වා ඇත. සාන්ද්‍රිත යූරියා සමඟ මිශ්‍රකිරීමෙන්ද, සාන්ද්‍රිත යූරියා සහ ශර්කරා පැණිය සමඟ මිශ්‍ර කිරීමෙන්ද නැතහොත් ශර්කරා පැණියෙහි දියකළ යූරියා මිශ්‍ර කිරීමෙන්ද පිරියමට බඳුන් කළ පිදුරු යොදගෙන කළ පරීක්ෂණ අනුව සහ එසේ පිරියමට බඳුන් නොකළ පිදුරු යොදු ගෙන කළ පරීක්ෂණ අනුවද ඇතිවන ප්‍රතිඵල සංසන්දනය කරනු ලැබීය. සාන්ද්‍රිත යූරියා මිශ්‍රිත පිරියමට යූරියා ග්‍රෑම් 18/සාන්ද්‍රිත ග්‍රෑම් 100 ක් ඇතුලත් වූ අතර, ශර්කරා පැණියෙහිලූ යූරියා මිශ්‍රිත පිරියමට වතුර මිලිලිටර් 100 ක දියකළ ශර්කරා පැණි මිලිලිටර් 7.0 කට මිශ්‍රකළ යූරියා ග්‍රෑම් 3.6 ක්/පිදුරු ග්‍රෑම් 100 ක් යන අනුපාතයට යොදන ලදී. සෝඩියම් හයිඩ්‍රොක්සයිඩ් ඉසින ලද ආකාරයෙන්ම ශර්කරා දියරයද ඉසින ලදී. ක්ෂාර පිරියම නිසා වියළි ද්‍රව්‍ය දිරවීමේ හැකියාව මෙන්ම ඓන්ද්‍රික ද්‍රව්‍ය දිරවීමේ හැකියාවද සෑහෙන දුරට වැඩිවිය. ශර්කරා පැණිය එකතු කිරීම නිසා පිරියමට බඳුන් නොකළ පිදුරු දිරවීමේ හැකියාව වැඩිවූ නමුත් පිරියමට බඳුන්කළ පිදුරුවල දිරවීමේ හැකියාව අඩුවිය. එහෙත් ක්ෂාර පිරියමට බඳුන් කළ පිදුරුවලට ශර්කරා පැණිය එකතු කිරීම නිසා පිරියමට බඳුන් නොකළ පිදුරු සමඟ සසඳා බැලීමේදී, වියළි පිදුරු ආහාරයට ගැනීමේ අනුපාතය 34% කින් වැඩිවූ බව පෙනී ගියේය. යූරියා සමඟ ශර්කරා

පැණිය මිශ්‍ර කිරීමෙන් විශේෂ වාසියක් ඇති නොවීය. ගොයම් පිදුරු ආහාරයට දීමේ ප්‍රමාණය ක්ෂාර පිරියම නිසා බොහෝ දුරට වැඩිකළ හැකි බව අවසාන නිගමනය වශයෙන් සඳහන් කළ හැකිය. කම්හල්වල, පිරියම් පිදුරු කැට කැම නිෂ්පාදනය කිරීමේදී අනුගමනය කරන පිළිවෙල අනුව ශර්කරා පැණිය එකතු කිරීමෙන් ජීර්ණ ශක්ති ආදනය වැඩිවී අධික ශක්ති සමබරතාවක් ඇතිවීමටද ඉඩ ඇත්තේය.

අලුත් සහ ලුණු දමා වේලන ලද ''තිලපියා මොසැම්බිකා පීටර්ස්'' මත්ස්‍යයා (වැව මාළුවා) තුළ ඇති රසායනික ගති ලක්ෂණ කීපයක්.

ද සිල්වා, එස්. එස්. සහ රත්ගොඩ, එම්.

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අලුත් සහ ලුණු දමා වේලන ලද තිලපියා මොසැම්බිකා නම් මත්ස්‍ය වර්ගයා තුළ ඇති රසායනික ගති ලක්ෂණ කීපයක් පරික්ෂණයට භාජනය කරන ලදී. මේ දත්වා විශ්ලේෂණයට භාජනය කොට ඇති වෙනත් මත්ස්‍ය වර්ගවලට වඩා තිලපියා මත්ස්‍යයා තුළ අධික කාබෝහයිඩ්‍රේට ප්‍රමාණයක් ඇත. ඌ අනුභව කිරීමට පුරුදු වී ඇති ආහාර වර්ග නිසා මේ වෙනස හටගෙන ඇත. මේ මත්ස්‍යයා ලුණු දමා කරවල වේලීමේදී ප්‍රෝටීන් හා කාබෝහයිඩ්‍රේට ප්‍රමාණය අඩුවන බව පෙනී ගොස් ඇත. කරවල වේලීමට කලින් දින මෙ මාළු ලුණු දියරයක බහා තබන නිසා එම මාළුවල ඇති දියවන සුළු ප්‍රෝටීන වර්ග සහ කාබෝහයිඩ්‍රේට වර්ග ඉවත්වී යාම මේ පෝෂ්‍ය ගුණය අඩුවීමට හේතුව වශයෙන් දැක්විය හැකිය. ලුණු දමා වේලන ලද කරවලවල ඇති ප්‍රෝටීන්, කාබෝහයිඩ්‍රේට සහ හස්ම යන පදර්ථ අලුත් මාළුවලට වඩා බෙහෙවින් වෙනස්වන බවද සොයාගනු ලැබීය. ලුණු දමා වේලන ලද කරවලවල කැලරික අගය, (තාපජනක අගය) ග්‍රෑම් ඒකක ප්‍රමාණ ගෙන එකට සසඳා බැලීමේදී, අලුත් මාළුවලට වඩා 1.8 ගුණයකින් අධික බවද පෙනී ගියේය.

මිනිස් රජ්ජු රුධිරයෙහි ඇති සයනකොබැලමින් සහ පවුලේ ආදයම

දිසානායක, එස්.

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ඉතා අඩු ආදයම් ලබන පවුල්වලට අයත් ගර්භණී මව්වරුන් 23 දෙනෙකුගෙන් හා මධ්‍යක ආදයම ලබන පවුල්වලට අයත් මව්වරුන් 31 දෙනෙකුගෙන් ද ලබාගත් මිනිස් රජ්ජු (පෙකනිවැල්) රුධිරය තුළ ඇති සයනකොබැලමින් (විටමින් බී$_{12}$) ප්‍රමාණය තීරණය කිරීමට මෙම පරික්ෂණය පවත්වන ලදී. ඉතා අඩු ආදයම් ලබන පවුල්වලට අයත් මව්වරුන්ගේ රජ්ජු රුධිරයෙහි සයනකොබැලමින් ප්‍රමාණය, මධ්‍යක ආදයම් ලබන පවුල්වල මව්වරුන්ට වඩා බෙහෙවින් අඩුබව සොයාගනු ලැබීය.

කුරුඳු කොළ තෙල් ක්ෂේත්‍ර ආසවනය.

ජීවරත්න, ඩී. වී. එම්., ජැන්ස්, ර්. ආර්., උමාපති, සී., ගාමිණි, ඒ. ඒ. සුනිල්, මක්මුදෙව්, ඒ. සහ රාමසුන්දර, එන්. එස්. කේ.

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ශ්‍රී ලංකාවේ කුරුඳු කොළ තෙල් ආසවනය වර්ෂයකට රුපියල් කෝටි 2 ක ව්‍යාපාරික පිරිවැටුමක් ඇති සැලකිය යුතු කර්මාන්තයකි. එහෙත් දැනට භාවිත කරන එකද ආසවන ක්‍රමයක්වත් කාර්යක්ෂම නොවේ. මේ ලිපියෙන් පාරම්පරික ආසවන ක්‍රම ගැන හා ''සිසිරිල් මානකොකා'' නමැති ආසවන ක්‍රමය ගැනද කරන ලද ක්ෂේත්‍ර පරීක්ෂණ පිළිබඳව විස්තර කෙරේ. මේ ලිපියෙන් කුරුඳු කොළ තෙල් සිඳ ගතහැකි අලුත් සැලැස්මක් එනම් ''සිසිරිල් බොයිනර්'' නමින් හඳුන්වනු ලබන ආසවන යන්ත්‍රයක් ගැනද විස්තර කෙරේ. මේ අලුත් යන්ත්‍රය දැනට භාවිතා කරන සියළුම වාෂ්පශීලී තෙල් ආසවන යනත්‍රවලට වඩා කාර්යක්ෂම බව පෙනි ගොස් ඇත.

ප්‍රොස්ටාග්ලැන්ඩින් ප්‍රතිකාරයෙන් සහ කෙටිකාලීන ප්‍රොජෙස්ටෙරෝන් අන්තර්යෝනීය උපකරණ ප්‍රතිකාරයෙන් පසුව මී දෙනුන් තුළ (බුබාලුස් බූබාලිස්) ඇතිවන ලිප්ස (ඔසප්) ප්‍රතිචාරය සහ ගැබ්දැරීමේ අනුපාතය.

රාජමහේන්ද්‍රන්, ආර්., ජයතිලක, ටී. එන්., ධර්මවර්ධන, ටී. සහ රාජගුරු, ඒ. එස්. බී.

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ඔසප් චක්‍රයට අවතීර්ණවූද ක්‍රියාකාරී පීතදේහයන්ගෙන් යුක්තවූද මී දෙනුන් දහඅට දෙනෙකුට ප්‍රොස්ටාග්ලැන්ඩින් $F_{2\alpha}$ මිලි ග්‍රෑම් 30 ක බලය ඇති බෙහෙතක් පේශීන් තුලට එක්වරක් පමණක් විද ප්‍රතිකාර කරන ලදී. එයින් පසුව ඔසප් ප්‍රතිචාරය සහ ගැබ්දැරීම් අනුපාතය පිළිවෙලින් 16.6% සහ 11.1% යන ප්‍රතිශත අනුව පැවතිණි. අපිළිවෙලින් තෝරාගන්නා ලද පශ්චාත් ප්‍රසූතික දෙනුන් දහසය දෙනෙකුට දින 12 ක් තුළ ප්‍රොජෙස්ටෙරෝන් අන්තර්යෝනීය උපකරණයකින් ප්‍රතිකාර කරන ලදී. මේ උපකරණය ඇතුල්කළ වේලාවේ ඊතර් මිලිලීටර් 5 ක් මිශ්‍ර කරන ලද ඔයෙස්ට්‍රෝඩියල් 17β මිලිග්‍රෑම් 10 ක් ද විදින ලදී. එම උපකරණය දැරුම් අනුපාතය දෙනුන් නිදැල්ලේ හැසිරෙන විට 72% ක් වශයෙන්ද මඩුවේ බැඳ තැබූවිට 100% ක් වශයෙන්ද පැවතිණි. මේ උපකරණය දින 12 ක් දරාගෙන සිටි මී දෙනුන්ගෙන් සියයට හැත්තෑහත් දෙනෙක් උපකරණය ඉවත් කොට දින 4 සිට 5 දක්වා කාලයක් තුලදී ඔසප් චක්‍රයට නැවත අවතීර්ණ වූහ. සංසර්ගයෙන් දින 90 කට පසුව ගැබ්ගත් ප්‍රමාණය 62% කි. මී දෙනුන්ගේ ඔසප්වීම සමකාලීන කිරීම සඳහා ප්‍රොස්ටාග්ලැන්ඩින් ප්‍රතිකාරයට වඩා කෙටිකාලීන ප්‍රොජෙස්ටෙරෝන අන්තර්යෝනීය උපකරණ ප්‍රතිකාරය වඩා විශ්වාසදායක බව මේ ප්‍රතිඵලවලින් පෙනී යන්නේය.

එන්-බියුටිල් විනිල් ඊතර් පදර්ථය සමඟ මැලයික් දැන්හයිඩ්‍රයිඩ් පදර්ථයෙහි ඒකාන්තරණ සමග්‍රබහු අවයවීභවනය.

ෆුජිමෝරි, කියෝහිසා සහ වික්‍රමසිංහ, නන්ද ඒ.

J. Natn. Sci. Coun. Sri Lanka 1979 7(1): 45—55

එන්-බියුටිල් විනිල් ඊතර් (BVE) පදර්ථය මැලයික් ඇන්හයිඩ්‍රයිඩ් (MA) පදර්ථය සමඟ ක්ලොරෝෆෝම් ද්‍රාවණයක් තුළ ආමූල ආරම්භකයක් මගින් 1 : 1 ඒකාන්තරණ බහු අවයවයක් නිර්මාණය වනසේ සමග්‍රබහු අවයවීභවනයට පාත්‍ර කරන ලදී. 1 : 1 පෝෂක සංයුති මට්ටමේදී සමග්‍රබහු අවයවීභවන ආරම්භක අනුපාතය උපරිම අවස්ථාවක පැවති අතර, සීමාකාරී පරාවර්තනය සෛද්ධාන්තික සීමාකාරී පරාවර්තනයට ආසන්නව පැවතියේය. BVE සහ MA පදර්ථවල ආරෝපණ සංක්‍රාමණ (C – T) සංකීර්ණය 1, 2–ඩයික්ලොරෝතේන් ද්‍රාවණය තුළදී පාර ජම්බුල වර්ණාවලීක්ෂ (UV) අවශෝෂණ උපරිමය නැනෝමීටර් 270 ක පවතින බවද පෙනී ගියේය. මේ සංකීර්ණයෙහි ස්ටොයිකිමිතිය 1 : 1 ක්ව පැවතුණි. සංකීර්ණවීමේ සමතුලිතතා නියතයෝ න්‍යෂ්ටික චුම්බක සම්ප්‍රයුක්තතා වර්ණාවලීක්ෂය (NMR) මගින් සෙන්ටිග්‍රේඩ් අංශක 37 ක උෂ්ණත්වයකදී කාබන් ටෙට්‍රාක්ලෝරයිඩ් ද්‍රාවණය තුළ 0.37 dm^3/මවුල යන අනුපාතයෙන්ද පාරජම්බුල වර්ණාවලීක්ෂය (UV) මගින් සෙන්ටිග්‍රේඩ් අංශක 23 උෂ්ණත්වයක් යටතේ ක්ලෝරෝෆෝම් ද්‍රාවණය තුළදී 0.27 dm^3/මවුල යන අනුපාතයෙන්ද, 1, 2–ඩයික්ලොරෝතේන් ද්‍රාවණය තුළදී 0.11 dm^3/මවුල යන අනුපාතයෙන්ද පැවතියාහුය. BVE සහ MA පදර්ථවල ආරෝපණ සංක්‍රාමණ (C-T) සංකීර්ණය ඒවාට අයත් ඒකාන්තරණ සමග්‍රබහු අවයවීභවනයට පාත්‍ර වූ ආකාරය මේ ලිපියෙහි සාකච්ඡාවට භාජනය කොට ඇත.

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இந்த இதழின் கட்டுரைகளின் சுருக்கங்கள்

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(1) தேநீர் தயாரிக்குமிடத்து மரபுவழி ஏற்றுக் கொள்ளப்பெற்ற முறையின்படி கொதிக்கும் போதும் நொதிக்கும் போதும் பொலிபினோல், அமயினோ அமிலங்கள், ஆவிப்பறப்புள்ள சேர்வைகள் ஆகியவற்றில் ஏற்படும் மாற்றங்கள்.

**ஆர். எல். விக்கிரமசிங்கா, ஏ. ஏக்கநாயக்கா, சி. சீ. இராசசிங்கம்,
எம். ஜயந்தி த சில்வா.**

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தேநீர் தயாரிக்கும் மரபுவழி முறையின் படி அதிக நேரம் நொதிக்க வைப்பதனால் பிற தேயிலைக் கலக்கூறுகள் தேநீரிலுள்ள பொலிபினோலில் ஒட்டிக் கொண்டு அதன் கரைதிறன் குறைந்து விடுக்றது. நொதிப்பு நேரம் மொத்த அமயினோ அமில அளவினைப் பாதிப்பதில்லை. கொதிக்க வைப்பதனால் கட்டுண்ட பொலிபினோலும் மொத்த அமயினோ அமில அளவும் பெருகுவதோடு ஆவிப்பறப்புல்ளா சேர்வைகளும் வெகுவாகக் குறைகின்றன.

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(2) காரப் பண்பூட்டப்பெற்ற வைக்கோல். செம்மறி ஆடுகளின் உட்கோடல் அளவும் செரிமானத்திறனும் சக்தி, புரதமல்லா நைதரசன் குறைநிரப்பு மீது ஏற்படுத்தும் தாக்கம்.

எம். சீ. என். ஜயசூரியா.

J. Natn. Sci. Coun. Sri Lanka 1979 7(1): 5—9

சோடியம் ஐதரொட்சைட்டுப் பண்பூட்டப் பெற்ற வைக்கோலின் செரிமானத்திறனையும் விரும்பி அவற்றை உணவாகக் கொள்ளலையும் அடிப்படையாகக் கொண்டு, சக்தி, புரதமல்லா நைதரசன் குறைநிரப்பு மீது ஏற்படும் தாக்கத்தினை அளவிட, கலப்பினச் செம்மறி ஆடுகளுக்கு அந்த வைக்கோலினை உணவாகக் கொடுத்து நடாத்தப்பட்ட பரிசோதனையொன்று பற்றிய விபரம் இங்கு குறிப்பிடப்பட்டுள்ளது. செறிவார்ந்த யூரியாவோடு கலக்கப்பெற்றும், செறிவார்ந்த யூரியாவோடும் சக்கரைப்பாகோடும் கலக்கப்பெற்றும், அல்லது சக்கரைப்பாகில் கரைத்த யூரியாவோடு கலக்கப் பெற்றும் பண்பூட்டப்பெற்ற வைக்கோலினைப் பயன்படுத்தி மேற்கொண்ட பரிசோதனைகளின் வண்ணமும், அவ்வழிப் பண்பூட்டப்பெறாத வைக்கோலினைப் பயன்படுத்தாது மேற் கொண்ட பரிசோதனைகளின் வண்ணமும்,

ஏற்பட்ட விளைவுகள் ஒப்புநோக்கப் பெற்றன. செறிவார்ந்த யூரியாகலந்த பண்பூட்டல் 18/- கிராம் யூரியா/100 கிராம் செறிவு என்னும் விகிதத்தில் இருந்த தோடு, சக்கரைப் பாகிலிட்ட யூரியாகலந்த பண்பூட்டல் 100 மிலிலீட்டர் நீரில் கரைக்கப்பட்ட சக்கரைப்பாகு 7.0 மிலிலீட்டர்/3.6 கிராம் யூரியா-100 கிராம் வைக்கோல் என்ற விகிதத்தில் அமைந்திருந்தது. சோடியம் ஐதரொட்சைட்டினைத் தூவிய அதேமுறையில் சக்கரைப்பாகும் தெளிக்கப்பட்டது. காரப் பண்பூட்டல் காரணமாக உலர்ப்பொருட் செரிமானத் திறனும் சேதனவுறுப்புப்பொருட் செரிமானத்திறனும் பெரும்பாலும் பெருக்கமடைந்தன. சக்கரைப்பாகுச் சேர்ப்பின் காரணமாகப் பண்பூட்ட பூட்டப்பெருத வைக்கோலின் செரிமானத்திறன் அதிகரித்ததெனினும் பண்பூட்டப்பெற்ற வைக்கோலின் செரிமானத்திரன் குறைவுற்றலாயிற்று, ஆயினும் சக்கரைப்பாகினைக் காரப்பண்பூட்டப் பெற்ற வைக்கோலுடன் கலக்கப்பெற்றதனால், பண்பூட்டப்பெருத வைக்கொலுடன் ஒப்பு நோக்கப்பட்டவிடத்து, உலர்ப்பொருள் உணவாகக் கொள்திறன் 34% ஆல் அதிகரித்ததென்பதும் புலனாகியது. யூரியாவுடன் சக்கரைப்பாகினைச் சேர்ப்பதனால் விசேட நலனேதும் ஏற்படவில்லை. வைக்கோல் உணவாகக் கொடுக்குமளவு காரப்பண்பூட்டலால் பொரும்பாலும் அதிகரிக்கலாமென்பது இப்பரிசோதனையின்படி கண்ட முடிபாகும். பண்பூட்டப் பெற்ற வைக்கோல் குளிகைகளைத் தயாரிக்கும் தொழிற்சாலைகளில் அனுசரித்துவரும் அதே தொழில்முறையின்படி சக்கரைப் பாகினைச் சேர்ப்பதனால் செரிமானச்சக்தி உட்கோடல் அதிகமாகிக் சக்திச் சமநிலை ஏற்படவும் இடமுண்டு.

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(3) மனித நாண் குருதியிலுள்ள சயனகோபெலமின் சத்துப் பொருளும் குடும்ப வருமானமும்.

எஸ். திஸாநாயக்கா.

J. Natn. Sci. Coun. Sri Lanka 1979 7 (1):

மிகக் குறைந்த வருமானமீட்டும் குடும்பங்களைச் சேர்ந்த 23 கர்ப்பிணித் தாய்மார்களிடமிருந்தும் சராசரி வருமான மீட்டும் குடும்பங்களைச் சேர்ந்த 31 தாய்மார்களிடமிருந்தும் பெற்றுக் கொண்ட மனிதநாண் (கொப்பூழ்நாண்) குருதியிலுள்ள சயனகோபெலமின் (விட்டமின் பீ12) சத்துப்பொருள் அளவினைக் கண்டறிதற்கு இப்பரிசோதனை மேற்கொள்ளப் பட்டது. மிகக் குறைந்த வருமானமீட்டும் குடும்பங்களைச் சேர்ந்த தாய்மார்களது நாண்குருதியிலுள்ள சயனகோபெலமின் அளவு, சராசரி வருமானமீட்டும் குடும்பங்களைச் சேர்ந்த தாய்மார்களிலும் பார்க்க, மிகவும் குறைவுற்றிருப்பது கண்டுபிடிக்கப்பட்டது.

(4) ''திலப்பியா மொசாம்பிக்கா பீற்றர்ஸ்'' என்ற மீன் இனத்தைச் சேர்ந்த புதிய மீனிலும் அதன் உப்புபோட்ட கருவாட்டிலும் காணப்படும் சில இரசாயணப் பண்புகள்.

எஸ். எஸ். த சில்வா, எம். றங்கொட.

J. Natn. Sci. Coun. Sri Lanka 1979 7(1):

திலப்பியா மொசாம்பிக்கா எனப்படும் மீனினத்தைச் சேர்ந்த புதிய மீனிலும் அதன் உப்பு போட்ட கருவாட்டிலும் உள்ள இரசாயனப் பண்புக் கூறுகள் சில பரிசோதனைகளுக்குட்படுத்தப் பட்டன. இதுவரை பகுப்பாய்விற்குட்படுத்தப்பெற்ற ஏனைய மீனினங்களை விட திலப்பியா மீனில் கூடுதலான கார்போவைதரேற்றுப் பொருள் உண்டு. அது உண்ணப் பழகிக் கொண்டுள்ள சில உணவுவகைகளால் இவ் வித்தியாசம் ஏற்பட்டுள்ளது. இம் மீனினை உப்பு போட்டுக் கருவாடாக உலர்த்தும் நேரத்தில் புரதங்களும் கார்போவைதரேற்றுக்களும் நீக்கமுறுகின்றன வென்பது கண்டறியப்பட்டுள்ளது. கருவாடு உலர்த்தற்கு முந்திய இரவில் இம்மீன்களை உப்பு நீரில் இடுவதனுல் அம்மீனிலுள்ள கரையுந்தகவுடைய புரதப்பொருளும் கார்போவைதரேற்றுக்களும் கரைந்து போதல் இச்சத்துக் குறைவுக்குக் காரணமெனக் கொள்ளலாம். உப்பு போட்டு உலர்த்தப்பெற்ற கருவாட்டிலுள்ள புரதம், கார்போவைதரேற்று, சாம்பல் போன்ற பொருள்கள் புதிய மீனிலுள்ள அளவுகளோடு ஒப்பு நோக்கப்படுமிடத்து, பெரிதும் வேறுபடுமியல்பினவென்பதும் கண்டறியப்பட்டுள்ளது. உப்பில் இட்டு உலர்த்தப்பட்ட கருவாட்டின் கலோரிப் பெறுமானம், கிராம் ஒன்றிலுள்ள அளவுகளின்படி நோக்கப்பட்டகாலை, புதிய மீனில் அமைந்த அளவினைவிட 1.8 மடங்கு அதிகமாக விருப்பதும் புலனுகியது.

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(5) புறேற்ருகிலாண்டீன் பரிகாரத்தினதும் நெடுந்தவணைப் புறச்செற்றரேன் யோனிமடலகத்துக் கருவிப் பரிகாரத்தினதும் பின்னர் எருமைப் பசுக்களுக்கு (புபாலுஸ் புபாலிஸ்) ஏற்படும் காமவெப்பத் தூண்டப்பேறும் கருவுறல் விகிதமும்.

ஆர். இராசமகேந்திரன், கே. என். ஜயதிலக்கா,
ஜே. தருமவர்த்தன.

J. Natn. Sci. Coun. Sri Lanka 1979 7(1):

காம வெப்பச்சக்கரத்திற்குட் புகுந்து மஞ்சட்சடலச் சுறுசுறுப்பேற்பட்ட பதினெட்டு எருமைப் பசுக்களுக்குப் புறேற்ருகிலாண்டீன் F2α, 30 மிலி கிராம் வலுக்கொண்ட மருந்தொன்றை ஒரு தடவைமட்டும் தசையகத்துச் செலுத்தி பரிகாரம் அளிக்கப்பட்டது. அதன் பின்னர் ஏற்பட்ட காம

வெப்பத்தூண்டப்பேறும் கருவுறல் விகிதமும் முறையே 16. 6%, 11. 1% என்றவாறு அமைந்திருந்தன. ஒழுங்கற்ற முறையில் தேர்ந்தெடுக்கப்பட்ட கன்று ஈன்ற பதினாறு பெண் விலங்குகளுக்கும் 12 நாட் காலத்தில் புறச் செற்றரோன் யோனிமடலகத்துக் கருவியொன்றால் பரிகாரம் அளிக்கப் பட்டது. இக்கருவி செருக்கப்பட்ட நேரத்தில் 5 மிலிலீட்டர் ஈதர் கலக்கப்பட்ட ஓயெற்ரோடியல் 17β 10 மிலிகிராம் அளவு வீதமும் உட்செலுத்தப் பட்டது. அக்கருவியின் தாங்கல் வீதமானது, பசுக்கள் புல்தரையில் மேய விடப்பட்டிருந்த போது 72% என்றவாறும் மடுவத்தில் கட்டி வைக்கப்பட்டிருந்த போது 100% என்றவாறும் அமைந்திருந்தது. இக் கருவியை 12 நாட்களாகத் தாங்கிக் கொண்டிருந்த பெண் விலங்குகளில் நூற்றுக்கு எழுபத்தேழு பசுக்கள் அக்கருவி நீக்கப்பெற்று 4 முதல் 5 வரையான நாட்களில் காமவெப்பச் சக்கரத்திற்கு மீண்டன. பாலுறவு கொண்டு 90 நாட்களுக்குப் பின் 62 % பசுக்கள் கருவுற்றன. எருமைப்பெண் விலங்குகளிற் காமவெப்பமேற்படுதலானது ஒரே காலத்தில் நிகழச் செய்தற்குப் புரோற்றாகிலாண்டீன் மருந்தினை உட்செலுத்துவதை விடக் குறுந் தவணைப் புறச் செற்றரோன் யோனிமடலகத்துக் கருவிமுறை பெரிதும் நம்பிக்கை வாய்ந்ததென்பதை இப்பரிசோதனைகள் காட்டுகின்றன.

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(6) களத்திலேயே கறுவா இலை எண்ணெய் வடித்தல்.

டீ. வீ. எம். ஜீவரத்தினா, ஈ. ஆர். ஜான்ஸ், சீ. உமாபதி, ஏ. ஏ. காமினி, ஏ. மக்தோவ், என். எஸ். கே. ராமசுந்தரா.

J. Natn. Sci. Coun. Sri Lanka 1979 7 (1):

இலங்கையில் கறுவா இலை எண்ணெய் வடித்தலானது ஓராண்டுக்கு 2 கோடி ரூபா மொத்த விற்பனவுடைய மிக முக்கியத்துவம் வாய்ந்த தொழில் ஆகும். ஆயினும், இப்பொழுது வழக்கிலுள்ள எந்தவொரு வடிப்பு முறையும் வினைத்திறமை கொண்டதாக இல்லை. இக்கட்டுரையில் மரபு வழிவந்த வடிப்புமுறைகள் பற்றியும் ''சிசிறில் மாணாகொக்கா'' எனப்படும் வடிகருவி பற்றியும் மேற்கொள்ளப்பட்ட பரிசோதனைகள் விளக்கப்பட்டுள்ளன. இக்கட்டுரை கறுவா இலை எண்ணெய் வடித்தற்குகந்த புதிய வடிவமைப்பு கொண்ட ''சிசிறில் பொய்த்தர்'' எனப்படும் வடிகருவி பற்றியும் விளக்கியுள்ளது. இப்புதிய கருவியானது இப்பொழுது பயன்பாட்டிலுள்ள ஆவியாகும் எண்ணெய் வடிக்கும் எல்லா இயந்திரங்களையும் விட மிகுந்த வினைத்திறமை கொண்டியங்குமென்பதும் நிரூபணமாகியுள்ளது.

(7) என்—பியூற்றில் வினில் ஈதர்ச்சேர்மநீர்மத்துடன் மலாயிக்கனைகரைட்டின் ஒன்றுவிட்ட கூட்டுப்பல்பகுதிஇணைவு.

இயோகிசா பூஜிமோரி, நந்த ஏ. விக்கிரமசிங்கா.

J. Natn. Sci. Coun. Sri Lanka 1979 **7** (1):

என்—பியூற்றில் வினில் ஈதர்ச் சேர்மநீர்மம் (BVE) மலாயிக்கனைதரைட்டோடு (MA) குளோறோபோம் கரைசலில் மூலிக தொடக்கியொன்றின் மூலம் 1:1 ஒன்றுவிட்ட பல்பகுதியமொன்று தோன்றும் வண்ணம் கூட்டுப் பல்பகுதிஇணைவுக்குட்படுத்தப்பட்டது. 1:1 என்ற ஊட்டலமைப்பு மட்டத்தில் கூட்டுப்பல்பகுதி இணைவுத்தொடக்க வீதம் உச்சநிலையில் அமைந்திருந்ததோடு எல்லைமாற்றமானது கோட்பாட்டு எல்லை மாற்றத்திற்கு அணிமையில் இருந்தது. BVE, MA ஆகிய சேர்மநீர்மங்களின் ஏற்றப் பெயர்ச்சிச் (CT) சிக்கலானது 1,2—இரு குளோறோதேன் கரைசலில் அப்பாலூதா நிறமாலைமானி (UV) உறிஞ்சற் பெருமம் நனோமீட்டர் 270 அளவில் இருப்பதாகவும் கண்டறியப்பட்டது. இச்சிக்கலின் பீசமானம் 1:1 ஆகவிருந்தது, சிக்கலாதற் சமநிலைமாறுமதிப்பளவுகள் கருக்காந்தபரிவு நிறமாலைமானி (NMR) வழியாக சென்றிகிறேட் 37 பாகை வெப்பத்தின் கீழ் காபன் முக்குளோரைட்டுக் கரைசலில் 0.37dm³ மூல் என்ற வீதத்திலும், அப்பாலூதா நிறமாலைமாணி (UV) வழியாக சென்றிகிறேட் 23 பாகை வெப்பத்தின் கீழ் குளோரோபோம் கரைசலில் 0.27 dm³ மூல் என்ற வீதத்திலும், 1,2—இருகுளோறோதேன் கரைசலில் 0.11=dm³ மூல் என்ற வீதத்திலும் அமைந்திருந்தன. BVE, MA ஆகிய சேர்மநீர்மங்களின் ஏற்றப்பெயர்ச்சிச் (C-T) சிக்கல் அவற்றுக்குரிய ஒன்று விட்ட கூட்டுப்பல் பகுதி இணைவுற்கு உட்படுத்தப்பட்ட முறை இக்கட்டுரையில் ஆராயப் பட்டுள்ளது.

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