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# *Characterisation of Natural Rubber Latex from Mistletoes Infested* Hevea *Trees of NIG 804 Clones*

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*This paper reports on the effects of mistletoes infestation of* Hevea *rubber trees on the physico-chemical parameters of natural rubber latex.* Hevea brasiliensis *trees of NIG 804 clones infested by mistletoes were identified and grouped as low, medium and highly infested trees. The latex from each of the grouped trees were tapped and collected over a period of twenty-four months using ½S d/2 tapping method without stimulation. During tapping, the plugging index, intensity of plugging and flow rates were determined. Thereafter, the latices were characterised using the following test parameters: total solid content, dry rubber content, nitrogen content, mechanical stability time and volatile fatty acid. The study revealed that there is a relationship between the level of infestation and the quantity of latex exuded from the trees whereas no relationship was noticed between the level of infestation and the quality of natural rubber latex. Above all, it was observed that the results obtained from the mistletoes' infested trees were well compared in relationship to practical application of the natural rubber latex from uninfected* Hevea *rubber tree.*

**Key words**: mistletoes; infestation; plugging index; solid content; rubber content; nitrogen content; mechanical stability time; volatile fatty acid

Natural rubber occurs as a milky colloidal aqueous dispersion of rubber particles known as latex[1]. Rubber is a term applied to a wide variety of elastic substance produced from over 500 plant species, while the outstanding commercial source of natural rubber is the *Hevea*[2,3]. Several clones of *Hevea* are being developed nowadays with emphasis on the yield capacity, good growth with long life span, resistance to diseases and winds. However, there is a fear that a high latex producing clone, susceptible to mistletoe attack might produce latex of poor quality[3,4].

Mistletoes are parasites that feed on their host with their seeds usually carried about by birds. There is a dearth of information on the effects of mistletoes (*Loranthus spp*.) on the qualitative as well as quantitative parameters of rubber latex in Nigeria. This information is

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needed for the effective handling and processing of the product into desired consumer goods. Fears of the negative effects of the parasites on the rubber latex have been expressed by local farmers (personal communication), since mistletoes feed on some of the nutrients suppose to be available for the host, which might result in deficiency of such nutrients to the host. However, these fears must be empirically confirmed and hence the need to emphasise on the quality and quantity of latex and rubber that will be produced from such mistletoes infested *Hevea* trees.

Begho *et al.*[5] carried out some preliminary studies on the biology and incidence of mistletoes on rubber trees in Nigeria and found that mistletoes growing points on *Hevea* trees could be up to 35 with the resultant taking over of the foliage of rubber trees. Farmers fears that the foliage damage might lead to poor latex yield and can even cause total death of the rubber tree if the level of parasitism is very high. Therefore, knowledge of the quality of the whole field latex is needed for its appropriate utilisation and hence the objective of this study was centred on the latex flow rate, plugging index, and quality of the latex from such mistletoes infested trees of *Hevea brasiliensis*.

## DESIGN OF EXPERIMENTS

### Selection of Rubber Trees

The selection of the infested and non-infested trees used in this study was carried out in the dry season in order to accurately count the number of mistletoe growing points on the trees. The levels of incidence of the mistletoes on the rubber trees were rated as shown in *Table 1*. The trees were properly labelled according to the level of mistletoe infestation for easy identification. A minimum of 100 trees were used for each group. Monitoring of the mistletoes points on the trees were maintained through out the period of the experiment.

Field latex from the infested *Hevea* trees of NIG 804 clone was obtained by ½S d/2 tapping system from the estates of the Rubber Research Institute of Nigeria over a period of 24 months. Analysis on the latex was always carried out immediately after collection.

### Determination of Physical and Chemical Parameters

*Plugging index*. This is the ratio of rate of flow during the first 5 min over the total volume of latex exuded multiplied by 100 (see *Equation 1*)[2].

$$\text{Plugging index (PI)} = (V_1/V_2) \times 100 \quad \ldots 1$$

Where $V_1$ is the volume of latex that flows during the first 5 min and $V_2$ is the total volume of latex that exuded out.

*Intensity of plugging (IP)*. This is determined by using the empirical formula:

$$\text{IP} = \frac{(b - a) \times 100}{b} \quad \ldots 2$$

Where $a$ is the volume of latex exuded 2 min before re-tapping and $b$ is the volume of latex exuded 2 min after re-tapping.

*Flow rate*. This is the volume of rubber latex that exudes from the rubber tree within a specific time. However, in this experiment the flow rate was measured by taking the volume of latex exuded within the first 5 min after tapping. This gives an idea of the rubber regeneration within the tree.

TABLE 1. RATING OF MISTLETOE-INFESTED RUBBER TREES AND THEIR CORRESPONDING CATEGORIES

| Rating | Number of mistletoes per tree |
|---|---|
| None | 0 |
| Low | 1–4 |
| Medium | 5–10 |
| High | ⩾11 |

*Total solid contents*. The total solid content (TSC) was determined by adopting the *ISO 124* method[6]:

$$\text{TSC (\%)} = \frac{M_0 - M_1}{M_0} \times 100 \qquad \ldots 3$$

Where $M_0$ is the mass in grams of the wet latex and $M_1$ is the mass of the latex after drying.

*Dry rubber contents*. The dry rubber contents (DRC) was determined by adopting the *ISO R126* method[7]:

$$\text{DRC (\%)} = \frac{M_1}{M_0} \times 100 \qquad \ldots 4$$

Where $M_0$ is the mass in grams of latex and $M_1$ is the mass in gram of dry sheet.

*Volatile fatty acids*. This was determined in accordance with *ISO 506* of 1992[8] . The result was expressed as follows:

$$\text{VFA} = \left(\frac{134.64\ CV}{\text{TSC}}\right) \times \left(\frac{50 + m(100 - \text{DRC})}{100\ \rho}\right) \ldots 5$$

Where $C$ is the actual concentration of barium hydroxide solution; $V$ is the volume ($cm^3$) of barium hydroxide solution required to neutralise the distillate; $m$ is the mass in grams of test portion; DRC is the dry rubber content of the latex; TSC is the total solids contents of the latex; $\rho$ is the density of the serum and 134.64 is a factor used in calculating VFA.

*Mechanical stability time (MST)*. The procedure[9] described in *ISO 35* of 1989 was adopted to determine the MST of latex.

*Nitrogen content*. The nitrogen content (NC) of the latex was determined by adopting the procedure[10] described in *ISO 1656(E)*. All reagents were of analytical grade.

## RESULTS AND DISCUSSION

The results obtained from the characteristics of the *Hevea* latices from the mistletoes infested NIG 804 clone were as given in *Table 3*. The result of the flow rates ranges from 2.9 ± 0.3 for latex from the highly infested *Hevea* trees to 4.2 ± 0.3 for latex from the none and low infested *Hevea* trees. This showed that latex flow faster in non-infested *Hevea* trees, and as the level of infestation increases, flow rates decreases, signifying the effect of the mistletoes on the rate at which latex exudes from the trees, which could have been caused by the parasitic activity of the mistletoes on the host.

TABLE 2. A TYPICAL COMPOSITION OF *HEVEA* LATEX[a]

| Constituents | (%) |
|---|---|
| Rubber hydrocarbons | 35–40 |
| Proteins | 1.0 |
| Lipids | 0.9 |
| Carbohydrates | 1.0 |
| Minerals | 0.5 |
| Water | 50–60 |

[a]As contained in Akinlabi A. K. *et al.*[2]

The PI ranged from 13.0 ± 1.0 for latex from the none infested *Hevea* trees to 20.0 ± 1.5 for latex from the highly infested *Hevea* trees. This showed an increase of 35%, which was very significant. These results clearly signify that *Hevea* trees with higher level of mistletoes infestation produced *Hevea* latex of lower quantity (with about 35%) than the latex from a none infested *Hevea* tress.

The result of IP was found to be constant. This was expected resulting from the fact that the experiments always started very early in the morning on each alternate day and this means that no latex flow will be observed before tapping commences on a fresh alternate day, thereby making the result of the IP being constant for all the samples.

The result of the TSC was observed to be very close. It ranged from 41.0 ± 1.32 for latex from the non-infested *Hevea* trees, to 40.5 ± 1.30 for latex from the low infested *Hevea* trees, to 41.0 ± 1.31 for latex from the medium infested *Hevea* trees, and to 41.0 ± 1.33 for latex from the highly infested *Hevea* trees. These results indicated that the level of mistletoes infestation on an *Hevea* tree did not have a pronounced effect on the TSC of *Hevea* latex obtained from such infested tree.

The result of the DRC did not deviate much from the trend observed in the result of the TSC. The DRC results ranged from 37.5 ± 1.30 for latex from the non-infested *Hevea* trees, to 37.0 ± 1.32 for latex from the low infested *Hevea* trees, to 37.0 ± 1.34 for latex from the medium infested *Hevea* trees, and to 37.5 ± 1.30 for latex from the highly infested *Hevea* trees. The DRC of a latex has been found to be of economic importance and physiological interest, as it reflects the quantity of rubber extracted from the tree and can be influenced by many factors including cultivars and age[11]. Rubber marketers are always interested in the DRC because of its commercial interest in the marketing of natural latex (the higher the DRC, the higher the price per kilogram)[2,4]. Hence the independence of the DRC on the level of mistletoes infestation has solved the fears of rubber farmers on the quality of rubber latex that can be exuded from mistletoes infested *Hevea* trees.

The MST of the latices was indicated by the time for flocculation to occur when the latex was stirred at the ISO specified temperature and speed. Mechanical stability is a measure of the resistance of the latex particles to irreverse flocculation or coagulation. Mechanical stability of latex had been shown to be influenced by a number of factors such as VFA, amounts of metal ions and duration of storage[2]. The results in *Table 3* show that latex from non-infested and low infested trees gave mechanical stability of 552 sec; latex samples from medium infested trees gave 534 sec; while the least flocculation time of 522 sec was observed for latex from the highly infested trees. This showed that as the level of infestation increased, the MST decreased probably caused by the mistletoe's parasitic effect on the VFA, in enhancing the microbial activity, thereby leading to faster coagulation rate and low mechanical stability. A moderate MST of 600 sec is specified for natural rubber latex[9], and the results of this work had shown that latices from mistletoes infected trees would also be suitable for product development and commercialisation.

VFA are products of bacterial action on latex[8]. VFA is an indication of the efficiency of the preservative used and it is usually measured by VFA number defined as the number of grams of potassium hydroxide equivalent to the VFA contained in 100 g of total solids. The VFA values of the latex samples was found to range from 0.13% for low infection to 0.18% for high infection. These result seemed to indicate that as the level of infection increased, VFA values also increased, indicating further that mistletoes might have enhanced the bacterial activity of the natural rubber latex from the infested *Hevea* trees. Shum and Wren have found that high VFA content could lead to spontaneous coagulation of the latex[12] hence, VFA has influence on the mechanical stability of latex. Ferreira *et al*. also confirmed that the higher the volatile fatty acids content, the lower the stability of the latex[13].

The protein content was determined in terms of the nitrogen content of the samples. The results range from 0.58% for low infection, 0.54% for medium to 0.52% for high infection. This result showed that as the level of infestation increased nitrogen content values decreased indicating that the mistletoes could have possibly fed on some of the nitrogen of the *Hevea* trees. This observation could still be linked to the higher VFA values and faster spontaneous coagulation observed in latex from the highly mistletoes infested *Hevea* trees. Archer *et al*.[1] and Cocktain *et al*.[14] reported that some non-rubber moieties such as amino acids and metal ions, though present in small quantities have

TABLE 3. CHARACTERISTICS OF LATEX FROM MISTLETOES INFECTED *HEVEA* TREES

| Parameters | Level of infection | | | |
|---|---|---|---|---|
| | None | Low | Medium | High |
| Plugging index (%) | 13.0 ± 1.0 | 14.0 ± 1.0 | 16.0 ± 1.0 | 20.0 ± 1.5 |
| Intensity of plugging (%) | 99.0 ± 0.2 | 99.0 ± 0.2 | 99.0 ± 0.2 | 99.0 ± 0.2 |
| Flow rate[17] | 4.2 ± 0.3 | 4.2 ± 0.3 | 3.6 ± 0.2 | 2.9 ± 0.3 |
| Total solid content (%) | 41.0 ± 1.32 | 40.5 ±1.30 | 41.0 ±1.31 | 41.0 ± 1.33 |
| Dry rubber content (%) | 37.5 ±1.30 | 37.0 ±1.32 | 37.0 ±1.34 | 37.5 ±1.30 |
| Mechanical stability time (sec) | 552 ± 4.0 | 552 ± 8.0 | 534 ± 6.0 | 522 ± 7.0 |
| Volatile fatty acids (%) | 0.13 ± 0.12 | 0.13 ± 0.11 | 0.15 ± 0.12 | 0.8 ± 0.16 |
| Nitrogen content (%) | 0.59 ± 0.27 | 0.58 ± 0.20 | 0.54 ± 0.30 | 0.52 ± 0.25 |

Result for each parameter represents the mean for a 24 month-period of study.

been reported to have profound effects on the physical, chemical and mechanical properties of rubber. The decomposition of amino-acids (proteins) by microbial action (putrefaction) leads to an increase in the volatile fatty acids and the release of obnoxious gases. Therefore, protein constitutes extraneous materials in natural rubber latex as they affect its quality and the mechanical stability[15,16].

## CONCLUSION

Latices from the mistletoes infested *Hevea* rubber tree were characterised. The study revealed that mistletoes infestation on *Hevea* trees did not have any significant effect on the quality of the natural rubber latex from such infested trees. However, it had a pronounced effect on the quantity of latex that exuded out of the infested *Hevea* trees. The higher the level of infestation, the lower the quantity of natural rubber latex that would be exuded out. Latices from infested trees were also found to coagulate faster as a result of the high VFA .On the basis of the result obtained in this study, it is recommended that latices from mistletoes infested trees should be commercially accepted since they are by no means inferior to latex from uninfected trees. Above all, efforts should be made to properly preserve such latex and to also remove/reduce the number of mistletoes on any *Hevea* tree for proper latex flow and more economic benefits.

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