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Not to be folded or roughly handled

2343
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*Description of the process at present used for Manufacturing
"Cinchona Febrifuge" at the Sikkim Plantations.*

BY C. H. WOOD, GOVERNMENT QUINOLOGIST.

General object of the process.—The present method of treating cinchona bark was adopted as a temporary measure to afford the means of ascertaining the medicinal value of the proposed febrifuge. It was considered undesirable to incur any expenditure for factory buildings, machinery, or skilled labour, until the efficacy of the product as a remedial agent had been thoroughly determined by extensive trials. Consequently, it was necessary to so arrange the process that it could be conducted for some time on a considerable scale, and involve no other appliances than such as were already at hand.

General nature of the process.—The bark is crushed into small pieces (but not powdered) and is put into wooden casks, which are macerated in the cold with very dilute hydrochloric acid. The liquor is then run off into wooden vessels and mixed with an excess of a strong solution of caustic soda; a precipitate forms, which is collected on calico filters, and well washed with water. The filtrate is then dried at a gentle heat and powdered. It constitutes the crude febrifuge, which is then submitted to a process of purification. In the latter process a certain quantity of sulphuric acid, and a small quantity of a sulphur in caustic soda is added to the liquor. After the lapse of 24 hours the mixture is carefully filtered. The filtrate is mixed with caustic soda, and the residue is then ready for issue, and is sent out under the name of "Cinchona febrifuge."

Arrangement of the factory sheds.—A position was chosen conveniently near the dry bark godowns, and so situated on the side of the hill, that a copious supply of water could be obtained at a level with the roof of the sheds in which the maceration is conducted.

These sheds are rough temporary erections, constructed with saplings and a mat or thatch roof. Down the centre an open drain is cut to carry off the waste liquor. Over this drain some wooden stands are placed, on which the calico filters rest. The filters are formed by tying a square piece of calico to a wooden frame by the four corners. On each side of the shed is placed a row of 21 casks, standing on end upon a stand which elevates them about 2 feet from the ground. They are empty beer barrels, which have been purchased from the Commissariat Department at Darjeeling, the head removed, and the cask thoroughly cleansed; a hole is cut in the side of the cask at a level with the bottom, and closed with a cork. In front of the casks a row of tubs, formed by cutting beer barrels in halves, is placed, so that on uncorking the barrels the liquor will run out into the tubs.

Outside the shed, at one end, are a couple of large wooden vats at such an elevation that liquid can flow from them along a bamboo trough into any one of the barrels in the shed. The capacity of the vats, up to a mark on the inside near the top, is accurately determined. Water is run into the vat up to the mark, and a certain quantity of muriatic acid is added, and the whole well mixed. This diluted acid can then be run into any one of the casks in a line with the vat by means of a bamboo trough. In addition to the macerating sheds, there is a small brick building, heated with charcoal, in which the precipitate is dried; also a separate shed in which the process of purification is conducted.

Method of conducting the process.—The casks are worked in sets of three, and are marked A. B. C.

In each shed there are 14 sets; seven on each side. Each cask receives one maund of dry bark, which undergoes four successive macerations, the liquor being moved in rotation through the 3 casks. Each maceration lasts half a week. The liquid used for the fourth and last maceration is acidulated water drawn from the vat. When this is run off, it is moved into the next cask to form the third liquor. When this is drawn off, it forms the second liquor for another cask, and, when transferred from that, it goes on to new bark, from which it is drawn off and precipitated. The following table will show the manner in which this rotation is effected. Of course in starting a new shed every cask contains dry bark, consequently the system of rotation is not brought into full operation until after the first fortnight; and it is only after the shed has been in operation for 3½ weeks (June 7 in table) that the liquor for precipitation has been used for four macerations. The table is drawn for a new shed; after June 7th it is in regular order.

The liquor that is for precipitation is run into the tubs. The other liquors are drawn into wooden buckets and poured into the proper casks. The new acid is then drawn from the vats. The diluted acid is made in the vat by adding 1 gallon of muriatic acid to every 100 gallons of water (10 fluid-ounces to each cubic foot).

If three sheds are employed, No. 1 is worked on Mondays and Thursdays, No. 2 on Tuesdays and Fridays, and No. 3 on Wednesdays and Saturdays. It will be seen by the table that each set of three casks exhausts one maund of dry bark per week. Three sheds therefore, containing 42 casks each, would exhaust 42 maunds of bark every week.

The weight of acid used in the exhaustion is $6\frac{1}{2}$ per cent. of the weight of dry bark. It is obtained from Mr. Waldie's chemical works, at a cost of $3\frac{1}{2}$ annas per pound in Calcutta.

To precipitate the saturated liquor, a solution of caustic soda is added in excess. The caustic soda is obtained from England in 5-cwt. drums, costing from £15 to £20 per ton in London. One part of this is dissolved in 3 parts of water, and the solution stored in iron vessels. The quantity to be added to the bark liquor must be judged of by the appearance produced. When a sufficient quantity has been introduced, the precipitate assumes a somewhat curdy condition.

About $6\frac{1}{2}$ pounds of solid soda are used for every 100 pounds of dry bark.

The filtration is not commenced until the calico strainers which have been are returned until the liquid passes of a by the drain. After all the liquor has until it ceases to acquire a red tint, cream color. The precipitate is now suitable bins. It constitutes the crude

The process of purification.—The reddish-brown colour. It is therefore gallons of water are mixed with two powder are introduced. The alkaloids insoluble. About half a pint of a the whole allowed to stand for twenty the act of drying acquires a slightly a process of purification. Fourteen ric acid, and twenty pounds of the dry quantity of colouring matter remains in caustic soda is now stirred in, and is then filtered through calico into a clean vessel, care being taken to get the liquor perfectly bright. About 6 gallons of water are used to wash the sediment left on the filters. The clear filtrate is thoroughly mixed with solution of soda to precipitate the alkaloids; the precipitate is collected on calico, washed with a small quantity of water, drained, dried, and reduced to fine powder; it is then ready for issue.

Wooden tubs are used for this process, but they are not so well suited for the purpose as enamelled iron or earthenware. The purification is conducted in a separate shed by a man who is confined to that work.

The labour employed.—The only workmen employed in the factory are Nepalese coolies. When the process is once brought into full operation, it is found that these men readily master every detail, and conduct the whole thing with all the care and accuracy that is required. But of course the factory is under the supervision of Mr. Gammie, the officer in charge of the plantations, who visits it once a day, and sees that the work is being properly performed.

The bark used.—Dry succirubra bark only is employed. Moreover care is taken to mix the root, stem, and branch bark together in as nearly as possible the proportions in which they are yielded by the plantations. This mixture is broken into small pieces, and a maund of it goes into each cask. This is done to insure uniformity of composition in the product. Green bark is never operated on. It will be seen that the arrangement of the process requires that a certain weight of bark should be put into the casks every week throughout the year. This could not be done with green bark, because bark is only taken from the trees twice per annum. Apart from this, however, it has been found that dry bark yields a much better product, and quite as large a quantity. The small cost of drying the bark is more than counterbalanced by the advantages gained.

Temporary object of the process.—It is remembered that this method has only been adopted to furnish a large supply of febrifuge for trial; it does not profess to make the most economical use possible of the bark. The factory is estimated to turn out during the present financial year 4,000 pounds of febrifuge, which, at a rupee an ounce, will pay the whole cost of the plantations and manufacture for the year. If the product proves to be of permanent value as a remedial agent, it is probable that the process will be considerably modified to produce greater economy, but involving the use of permanent buildings and machinery.

SHED N. 1.

Casks marked B. C.

Thursday, May 13th	Put dilute acid in A.	1st liquor for A. (New bark is in A.)
Monday, " 17th	Run liquor from A. and precipitate. Put dilute acid in A.	2nd liquor for A.
Thursday, " 20th	Move liquor from A. to B. Put dilute acid in A.	1st liquor for B. (New bark is in B.) 3rd for A.
Monday, " 24th	Run liquor off B. and precipitate. Move liquor from A. to B. Put dilute acid on A.	2nd liquor for B. 4th for A.
Thursday, " 27th	Move liquor from B. to C. Move liquor from A. to B. Clean out A.	1st liquor for C. (New bark is in C.) 3rd for B.
Monday, " 31st	Run liquor off C. and precipitate. Move liquor from B. to C. Put dilute acid on B.	2nd liquor for C. 4th for B.
Thursday, June 3rd	Move liquor from C. to A. Move liquor from B. to C. Clean out B.	1st liquor for A. (New bark is in A.) 3rd for C.
Monday, " 7th	Run liquor off A. and precipitate. Move liquor from C. to A. Put dilute acid on C.	2nd liquor for A. 4th for C.
Thursday, " 10th	Move liquor from A. to B. Move liquor from C. to A. Clean out C.	1st liquor for B. (New bark is in B.) 3rd for A.
Monday, " 14th	Run liquor off B. and precipitate. Move liquor from A. to B. Put dilute acid on A.	2nd liquor for B. 4th for A.
Thursday, " 17th	Move liquor from B. to C. Move liquor from A. to B. Clean out A.	1st liquor for C. (New bark is in C.) 3rd for B.
Monday, " 21st	Run liquor off C. and precipitate. Move liquor from B. to C. Put dilute acid on B.	2nd liquor for C. 4th for B.
Thursday, " 24th	Move liquor from C. to A. Move liquor from B. to C. Clean out B.	1st liquor for A. (New bark is in A.) 3rd for C.

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DEPARTMENT OF REVENUE,
AGRICULTURE, AND COMMERCE.

AGRICULTURE AND HORTICULTURE.

To

The Honble Secy W.R.

No. ⁷
336

Simla, the 25th September 1876.

Recd 7. Oct -

8-11

8th Board of Dec. 1874
The Commission of the
Sikkim Plantations

Si Subto
J. Wood

SUBJECT.

DISTRIBUTES copies of Mr. Wood's description of
the process at present used for manufacturing
febrifuge at the Sikkim plantations.

Malaya

G. C. B. P., Simla-26-9-76-100,
No. 2543

communicated to the Board
of the Govt. of the Malaya
Minister of Forests