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ON MALT AND MALTING.

BY FRANK XAVIER MOERK, PH.G.

From an Inaugural Essay¹

Malt is described by the Pharmacopoeia as “the seed of *Hordeum distichum* caused to enter the incipient state of germination by artificial means, and dried.”

The process which the barley undergoes is termed “mailing,” and has for its object the production of soluble albuminoids, diastase, from the insoluble albuminous bodies present. These albuminoids possess the property of converting, under suitable circumstances, the starch of the grain into maltose, a fermentable sugar, and dextrin, a body closely related thereto. The formation of diastase proceeds first in the same proportion as the development of the embryo, but after the young plant has arrived at a stage when respiration through the plumula and assimilation through the rootlets can take place, the amount of diastase stored up in the grain gradually decreases. It is, therefore, the aim of the malster to arrest the growth of the germ at the moment when most diastase is accumulated in the grain, i. e., before the future stem surpasses the length of the grain. This is accomplished by killing the embryo by drying and heating.

Mailing consists of four operations: Steeping, Couching, Flooring, and Kiln-drying.

I. *Steeping*.—The barley is screened and sifted to remove broken or small grains, it is then let into a large cistern made of stone, iron, cement or wood. The water, temperature 10-13°C. (50-55°F.), is then added and allowed to cover the grain to a depth of 4 or 5 inches. The time required to steep the barley is about three days; the water is

¹ Mr. Moerk's thesis, presented to the Philadelphia College of Pharmacy, contains interesting investigations on barley and malt, but being quite voluminous, we deem it best to publish separately the different subdivisions or portions thereof.—EDITOR.

occasionally replaced by fresh water, in order to prevent putrefaction of the extracted matter.

II. *Couching*.—The barley, before it is thoroughly saturated, is thrown out of the cistern and put in large heaps on the couch. On thrusting the hand into the heap at the end of 24 hours, the length of time it is allowed to remain there, it does not feel moist. The grain, by this operation, has the benefit of a secondary steep with free access of air, the water adhering to the grain is mostly absorbed. The grain, when saturated, appears soft and flexible, and the husk will easily separate from the body, the latter, on pressing, becomes pulpy. The most characteristic indication of the penetration of the water is the appearance of a longitudinally split grain, the starchy body of which should be smooth and oily looking. The changes taking place while on the steep are as follows: Barley gains from 40 to 50 per cent. in weight and increases about 25 per cent. in bulk. About 1.5 per cent. is extracted, of which two-thirds is organic and one-third inorganic matter.

III. *Flooring*.—The barley is now thrown upon the floor to a depth of about 12 inches. The conditions required for a healthy germination are 1, the grain should have absorbed sufficient water while in the steep; 2, the steeped grain should be supplied with plenty fresh air; and 3, a certain, although only slight, amount of heat is required to introduce the activity of life into the grain. The first condition has been complied with in the previous operations. The second is fulfilled by turning the grain so that the portions in the centre and at the bottom are brought toward the top of the heap. This turning is made only once or twice a day for the first few days, but requires to be done oftener after the grain commences to germinate. The third condition is carried out by placing the grain to a considerable depth—12 inches—on the floor; by doing this, heat is generated after a time. The conditions having been complied with, oxygen is rapidly absorbed, and, in combining with part of the substance of the grain to form water and carbon dioxide, heat is generated which stimulates the growth of the young plant, after a time, to such an extent that the rise of the temperature in the mass of the growing grain must be checked. This is done by frequently turning the grain and laying it thinner every time it is turned. At the end of the fifth or sixth day, the grain covers the floor to a depth of 3 or 4 inches, and, as the grain then grows very slowly, it is necessary to stimulate the growth by gradually increasing the depth, so that at the end of this operation, the depth is about 9 inches. Very little change is noticed in

the barley until it has been about three days on the floor. On thrusting the hand into the heap at this time, it feels moist. This is called "sweating" by the malster, and here germination commences. The grain is allowed to remain on the floor until the acrospire, plumula, creeping along under the husk *almost* reaches the other end of the grain; if allowed to pass this, the diastase rapidly disappears. This is the best indication of the progress made during flooring, and corresponds with the increase of diastase. The time required for this operation varies from 8 to 12 days. The best temperature is 10-13°C. (50-55°F.); if the temperature exceeds 15°C., it does not take so long a time, but there is a greater loss of substance. This loss, by oxidation, at 10-13° C., amounts to 5 or 6 per cent., whilst with a higher temperature it amounts to as much as 15 per cent. In this operation is produced the diastase, and also a modification of the starch, so that it is readily acted upon by diastase.

IV. *Kiln-drying*.—The further growth of the grain is now stopped by drying it at a temperature varying from 32-71°C. (90-160°F.). It is placed, to a depth of from 6 to 9 inches, on a perforated iron floor and heated air caused to pass through it. A temperature of 32° C. (90° F.) is most approved of to get rid of the greater part of the moisture; 52-57°C. (125-135°F.) for gradually drying the malt; and, 65-71°C. (150-160°F.) to produce an aromatic flavor and reduce the moisture to from 2 to 1½ per cent. By using still higher heats, the variously colored malts are produced. In consequence of the last operation the malt combs, rootlets, become very brittle and are easily removed by sifting.

The loss in matting may be summed up as follows:

In steep.....	1·5 per cent.
Flooring.....	5· to 6· per cent.
Rootlets.....	2·5 to 3· per cent.
Total.....	9 to 10·5 per cent.

The above description is taken from "Steiner's Principles of Malting," corrected by Mr. T. M. Perot, so as to agree with the preparation of malt at his malt house.

Barley and malt have been the subjects of many analyses; but the results differed in nearly every one. The presence or absence of sugar and dextrin, one or both, were the points to which these differences were due. Mr. G. Kuhnemann, in 1875, was the first chemist to prove that cane-sugar was present in barley and malt, the latter also

containing another sugar capable of reducing Fehling's solution. On the other hand, he denied the presence of dextrin, this owing to his belief that dextrin reduced Fehling's solution. Researches made within the last few years, prove that dextrin, if pure, will not reduce the test solution, but commercial dextrin invariably reduces it, owing to the presence of more or less glucose. By repeatedly dissolving dextrin in water, precipitating by and washing with alcohol, glucose can be separated from the dextrin, and the latter will then not reduce Fehling's solution.

RED RESINS KNOWN AS DRAGON'S BLOOD.

BY J. J. DOBBIE AND G. G. HENDERSON.

Besides the red resins from *Pterocarpus Draco* and *Croton Draco*, there are three different recognized kinds of dragon's blood, one from the East Indies, *Calamus Draco*; one from Socotra, and one from the Canary Islands, *Dracæna Draco*. The first of these is the only one that has been fully described, but the results are not concordant; this is due apparently to the researches having been carried out on different substances. The authors have now investigated this subject, and have examined several varieties of the so-called dragon's blood, which they find can be arranged in four distinct groups: 1. Those which dissolve completely in chloroform, carbon bisulphide, and benzene; 2. Those soluble in chloroform, but insoluble in carbon bisulphide and benzene; 3. Those soluble in chloroform and benzene, and partly in carbon bisulphide; and 4. Those which are insoluble in all three reagents. The accuracy of this classification is supported by the physical properties of the resins and their behavior towards reagents, and it is evident, therefore, that there were four different kinds of resins under examination. All the resins dissolve to a small extent in boiling water, those of Class 4 being rather more soluble than the others; they are all freely soluble in alcohol, ether, oil of cloves, and glacial acetic acid, leaving a variable amount of insoluble matter, which usually consists of vegetable tissue, sand, etc. They are all slightly soluble also in hydrochloric acid, those of Class 2 being the most soluble; ammonia reprecipitates them from this solution. The aqueous and alcoholic solutions have an acid reaction. When treated with sodium hydroxide, the resins effervesce and emit an odor like that of rhubarb. Ammonia forms a clear mixture with the alcoholic solutions. The resins were carefully purified by means of ether, and then powdered; the results of

the individual class examinations may be thus summed up: Resin, 1, brick-red, melting at about 80°, when decomposed by heat gives off very irritating red fumes. It dissolves readily with an orange-red color in alcohol, ether, chloroform, carbon bisulphide, and benzene, but with difficulty in boiling caustic soda, ammonia, sodium carbonate, and with great difficulty in lime-water, whilst, in the cold, it is scarcely soluble in the first two and insoluble in the last two of the latter reagents. The ammonia solution is reddish-yellow, and a portion of the resin is not dissolved. The alcoholic solution gives a brown-red precipitate with lead acetate. Analysis (combustion and lead estimation) suggests the formula $C_{18}H_{18}O_4$. This variety is derived from *Calamus Draco*. Resin 2, $C_{17}H_{19}O_5$, origin uncertain, is carmine-red, melting at about 100°; when heated it gives off non-irritating fumes. It dissolves freely in alcohol, ether, and chloroform with a pink color, and in cold caustic soda, ammonia, sodium carbonate, and lime-water with purple color changing to orange-red or yellow on boiling, whilst it is insoluble in carbon bisulphide and benzene. The alcoholic solution gives a lilac-colored precipitate with lead acetate. Resin 3, $C_{18}H_{18}O_4$, from *Dræcena*, is vermilion, melting at about 80°; when heated it evolves aromatic irritating red fumes. It dissolves with a blood-red color in alcohol and ether, and in cold caustic soda, ammonia, lime-water, and sodium carbonate, but is insoluble in chloroform, carbon bisulphide, and benzene. Its alcoholic solution gives a mauve-colored precipitate with lead acetate. Resin 4, is a mixture of a reddish-brown resin, freely soluble in carbon bisulphide, and a light brick-red resin, nearly insoluble in that menstruum. The two portions differ considerably with regard to their solubility in ether, benzene, and other reagents, the dark portion being the less soluble of the two. Cinnamic acid was detected in the first and third varieties but not in the others. Johnstone found two resins in one kind of dragon's blood, to the one he gave the formula, $C_{20}H_{24}O_4$, and to the other, $C_{20}H_{21}O_4$.—*Phar. Jour. and Trans.* [3], 14, 361-364; *Jour. Chem. Soc.*, April, 1884, p. 462.

CASCARA AMARGA—HONDURAS BARK.

BY F. A. THOMPSON, PH.C., Detroit, Michigan,

Cascara Amarga, also known as Honduras Bark, is obtained from a tree indigenous to Mexico. A description of this tree I am unable to furnish. Specimens of this bark have been submitted to Dr. Vasey of the Department, of Agriculture at Washington, for examination, resulting in the opinion that it belonged to the genus *Picramnia* (from *picros*,

bitter, and thamnós, shrub), which numbers no less than twenty species. Dr. Vasey having only two varieties in his possession he was unable to determine the exact variety. *Picramnia* is said by different botanists to belong to the natural order Anacardiaceæ.



FIG. 1.—Cascara amarga, showing inner and outer surface; natural size.



FIG. 2.—Cross-section, magnified 5 times.

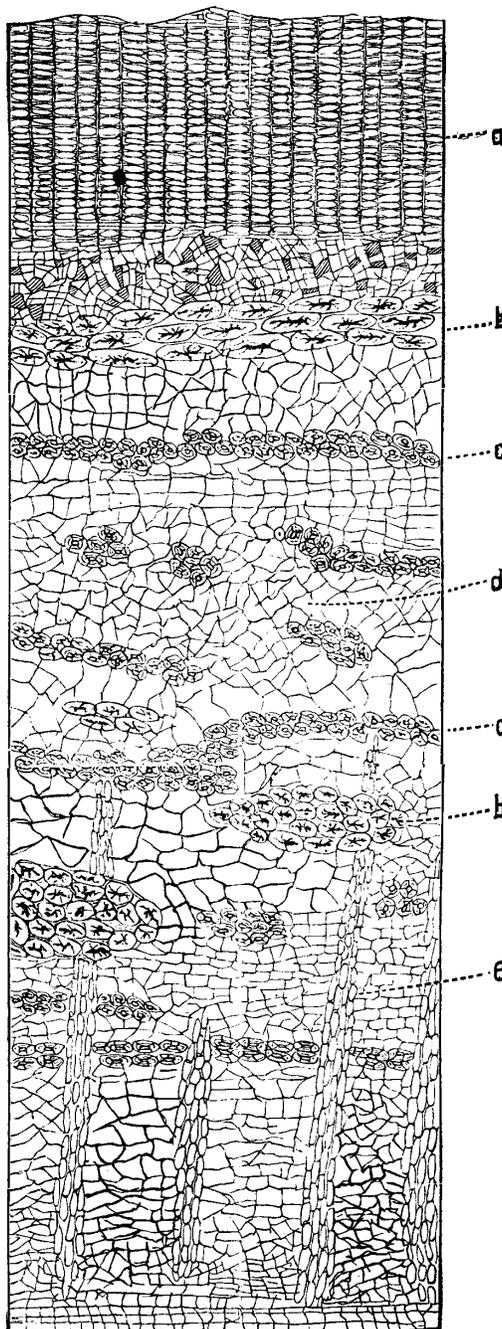


FIG. 3.—Transverse section magnified 75 diameters. *a*, outer bark or cork; *b*, sclerenchyma cells; *c*, sclerenchymatous or bast fibres; *d*, parenchyma cells; *e*, medullary rays.

The bark as seen in commerce, is mostly deprived of its outer bark which is from one to three millimeters thick, of a brownish-gray color, striated, and much divided by numerous longitudinal fissures. After being immersed in water, it assumes a greenish-yellow tint. The inner bark is of a deep-brown color, three or four millimeters thick, hard, and firm, of a bitter taste, and on examination of a transverse section numerous white spots are to be seen, which appear to be filled with a white insoluble inert substance.

Microscopical Examination:—The outer or cork bark (a) is composed of twenty-five or thirty rows of regular thick-walled cells, filled with red coloring matter. The middle bark is composed of large, irregular parenchyma cells (d) making up the greater share of the whole bark. Throughout this portion of the bark are numerous sclerenchyma cells (b) arranged in groups and also one to three rows are always found close to the outer bark. These sclerenchyma cells make a prominent marking, as seen with naked eye, in cross-section fig. 2. Also at intervals, are one to three ranked series of sclerenchymatous fibres or bast-fibres (c) arranged tangentially, which turn brown after treatment with iodine. The inner bark does not differ very much from the middle except it is divided by several rows of medullary rays (e) composed of regular cells.

Chemical Examination:—A portion of drug dried at 110°C until constant weight, was found to lose 10 per cent. as moisture. Another portion was incinerated, leaving a white ash amounting to 4.55 per cent.

Soluble in water: K, Na, sulphate, carbonate.....	1.10
Soluble in dilute hydrochloric acid; Aluminum, iron, phosphates and carbonates.....	2.89
Insoluble in sodium hydrate; sand.....	.56
Total.....	4.55

Several portions of drug were treated with benzol, alcohol and water ;

Amount extracted with benzol.....	2.72 per ct.
“ “ “ alcohol (.889 at 60°).....	10.00 “
“ “ “ cold water.....	4.16 “

The benzol residue was dried at a low temperature, that at 110°C. removing volatile oils and traces of moisture. This residue was treated with several portions of warmed acidulated water, this solution giving reactions for an alkaloid, with tannic acid, Mayer's reagent and other test-reagents. Residue was treated with eighty per cent. alcohol (sp. gr.

848 at 60°) dissolving resins leaving a residue of fixed oils, resins and wax.

The following table gives the systematic course of analysis:

Benzol extract contains : Volatile oils driven off at 110° C.....	·50	per ct.
Soluble in acid water, reactions for alkaloids.....	·22	“
Soluble in alcohol (.848), resins.....	·40	“
Insoluble in alcohol, wax, resins, etc.....	1·06	“
Total.....	2·72	“

Eighty per cent. alcohol extract contains :

Extractive matter.....	12·65	per ct.
Inorganic ash.....	·4	“
Matter soluble in water.....	9·00	“
Ash “ “ “	·50	“
Matter sparingly soluble, amorphous.....	·55	“

The dried alcoholic extract treated with several portions of absolute alcohol (.7938 at 60°) evaporated to a dry extract contains:

Matter soluble in water, including.....	6·34	per ct.
Tannin, organic acids, some extractives precipitated with lead sub-acetate.....	1·66	per ct.
Lead removed from solution with H ₂ S filtrate gave reactions for alkaloid with test reagents.	4·68	“
Insoluble in water.....	1·25	“
Soluble in dilute ammonia hydrate, acid resins.	·41	“
Insoluble in ammonia hydrate, neutral resins.	·84	“

Matter insoluble in absolute alcohol contains :

Soluble in water, including.....	3·55	“
Colors, some extractives precipitated with lead sub-acetate.....	2·01	“
Matter not precipitated with lead sub-acetate, freed from lead with H ₂ S gave reaction for alkaloid and trace of glucoside.....	1·54	“
Matter insoluble in water; containing.....	1·31	“
Soluble in acidulated water, reactions for alkaloids.....	·27	“
Insoluble in acid water, resins, extractives.....	1·04	“
Total extract.....	12·65	“

Remaining drug was treated with cold water, yielding 4.16 percent. extract; then with hot water containing sulphuric acid, changing starch into glucose, which was approximately estimated with a standard

Fehling solution, showing 1.94 per cent. calculated as starch.

A portion of drug was treated by the U. S. P. process for cinchona assay. The alkaloid solution after neutralizing with sodium hydrate was shaken out with several portions of a mixture of chloroform and ether, and allowed to evaporate at a moderate temperature, yielding 3 per cent. of brownish-yellow amorphous alkaloid, which has a sweetish taste at first, afterward becoming bitter. This alkaloid was treated with dilute sulphuric acid, hydrochloric, tartaric and others, but was unable to obtain crystals from any of the salts. Salts of this alkaloid are freely soluble in water, insoluble in ether or chloroform, are amorphous, forming a white powder when pulverized. Treated with strong sulphuric or nitric acid was unable to notice any colored reactions.

Several pounds of drug were treated with lime water, dried and exhausted with hot alcohol, which on cooling deposited a white amorphous substance, which was treated several times with hot alcohol and allowed to separate out on cooling as a white, crystallizable, tasteless substance, having a low fusing point, freely soluble in chloroform, less soluble in ether and benzin; insoluble in dilute acids and fixed alkalies, and when fused on platinum-foil develops a strong fat-like odor, reminding one of the odor of the fats when fused. A small portion allowed to crystallize from hot alcohol, deposited white, acicular-shaped. crystals.

The alkaloid, obtained in different ways, I would suggest to name, Picramnine.