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Homogenized Leaf Curing

II. Bright Tobacco*

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INTRODUCTION

The leaves of bright tobacco are customarily harvested in 5—7 successive operations and cured in heated barns (7). The cured leaf ideally is golden-brown in color and contains relatively high levels of reducing sugars and moderate amounts of nicotine.

During recent years, numerous advances have been made in the modernization of tobacco harvesting and curing in the United States (18, 9). The effects of these and other projected changes on tobacco quality have been discussed by *Weybrew* et al. (23). An important development in tobacco processing since 1950 has been the increasing use of reconstituted sheets in cigarette manufacture. Before 1970, cigarette tobacco contained about 15% of reconstituted sheets of stems and fines (12). Today, the figure is estimated to be as high as 30% in certain blends. Experiments with the harvest of whole plants by means of a forage chopper have been described. The tobacco is cut into small pieces, flue-cured, and reconstituted into sheets (6).

Any change in tobacco technology must be evaluated in terms of tobacco quality. Tobacco quality varies with leaf position, color, and texture. These criteria are used to establish the grade and support price for each lot of tobacco sold in the U.S.A. Grade and quality are also correlated with chemical composition of the leaf (3). Among other factors, grade and quality depend on the relative concentrations of carbohydrate and nitrogenous components in the cured leaf (16). A major aspect of tobacco quality, which has not received sufficient emphasis in the design of curing methods, is that of consumer safety. Although reconstituted-sheet processes were initially developed to salvage waste tobacco scraps, *Wynder* and *Hoffmann* (24) concluded, on the basis of biological assays, that reconstituted tobacco produces a smoke condensate that is significantly lower in tumorigenic properties [see also *Dontenwill* et al. (4)].

The major impetus to development of homogenized leaf curing (HLC) has been the use of substantial amounts of reconstituted sheet in tobacco blends and evidence that this material is less hazardous to health. Although the composition of tobacco before manufacture is determined primarily by soil, climate, and agronomic practices, tobacco can be modified to some extent during or after the curing phase by high-temperature or freeze-drying treatments (8). HLC involves curing tobacco in a completely macerated state. Some of the theoretical aspects of HLC are presented in a previous paper of this series (22). The chief objectives of HLC are the following: [1] Total mechanization of the harvesting and curing stages, [2] Acceleration of curing, [3] Manipulation of curing variables so as to obtain a safer product. Tobacco prepared by HLC is subsequently reconstituted into sheet. It is anticipated that, in the future, appropriate adjustment of curing variables, including extraction or addition of chemical components, will produce a safer tobacco for smoking. Alteration of these variables will be dictated in turn by data generated from bioassays of the smoke condensate. Research results to date indicate that HLC tobacco has lower biological activity than conventionally cured tobacco (22).

This communication describes the present status of the HLC process as applied to bright tobacco. Particular attention is focused upon the problems of designing HLC systems and the success achieved to date in producing a satisfactory cured product.

MATERIALS, METHODS AND APPARATUS

Field conditions

Nicotiana tabacum L. cv. Coker 319 (0.4 hectare) was grown at the Oxford Tobacco Research Station during the 1973 season. Plants were spaced 40.6 cm apart in the row and topped at 16 leaves. One-third of the crop was processed by homogenized leaf curing; the remaining two-thirds was harvested and cured by conventional methods as a control. Standard field practices were observed in all other respects. Suckers were controlled

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by sequential treatment with a contact chemical (OFF-Shoot-T) followed by a systemic chemical (Royal MH-30)*. No insecticides were applied.

Harvesting

A. Lower and Middle Leaves: The lower two-thirds of the plants used for HLC was hand-primed as the leaves ripened. To accelerate yellowing, leaves were placed on shallow trays in a specially constructed conditioning room maintained at 20° C and gassed with 350 ppm ethylene for 3 days before homogenizing (Figs. 1a and 1b). The ethylene gas was released into the sealed room at a rate of 75 cm^3/min. After the conditioning period, leaves were uniformly yellow, with little or no leaf deterioration, and leaf moisture decreased from 90% to 75%. The biochemical effects of ethylene on tobacco leaves have been described (17). Harvesting and processing lower and middle leaves extended over a 3-week period.

* All agricultural chemicals recommended for use in this report have been registered by the U. S. Department of Agriculture. They should be applied in accordance with the directions on the manufacturer's label as registered under the Federal Insecticide, Fungicide, and Rodenticide Act.

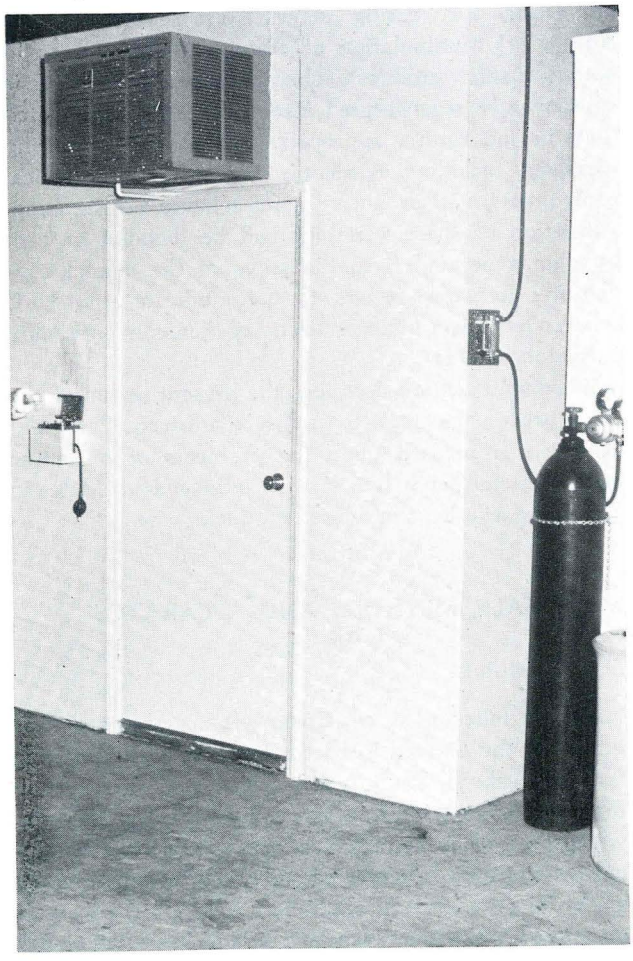
B. Upper Leaves: The upper one-third of the plants used for HLC was sprayed with ethephon (2-chloroethyl phosphonic acid, trade name: Ethrel, AmChem Products, Inc.) at a rate of 120 mg per plant. The use of ethephon for preharvest yellowing of tobacco has been reported previously (11). The ethephon treatment was staggered to provide the required amount of tobacco each day over a 5-day period. After 3 days, leaves from the treated plants were hand-harvested and processed immediately. Under the conditions described, yellowing was induced in all leaves remaining on the stalk (Fig. 2), and each plant was completely stripped of leaves at harvesttime.

Homogenizing

Yellowed leaves were homogenized without additional water by means of an extrusion food chopper (Fig. 3). During leaf maceration, sodium metabisulfite was dispensed into the grinding chamber to suppress oxidative browning. The antioxidant was added at a rate of 1 g per 450 g of leaf, to give a final concentration of approximately 0.02 M sodium metabisulfite based on fluid volume of the slurry. Leaf slurry was stored and transported in polyethylene barrels.

Figure 1. Ethylene-ripening room used for yellowing lower leaves after harvest.

a) Outside view of room showing air conditioner mounted over door, ethylene tank with flowmeter, and M.S.A. explosive gas monitor. Total volume was 24,580 liters, with a shelf capacity for about 250 kg fresh leaves. Temperature was held at 20° C.



b) Inside view of room, showing arrangement of trays and placement of leaves. Interior walls were lined with aluminum sheet and sealed at the seams with epoxy paint. Leaves were sufficiently yellowed after gassing with ethylene for 3 days.

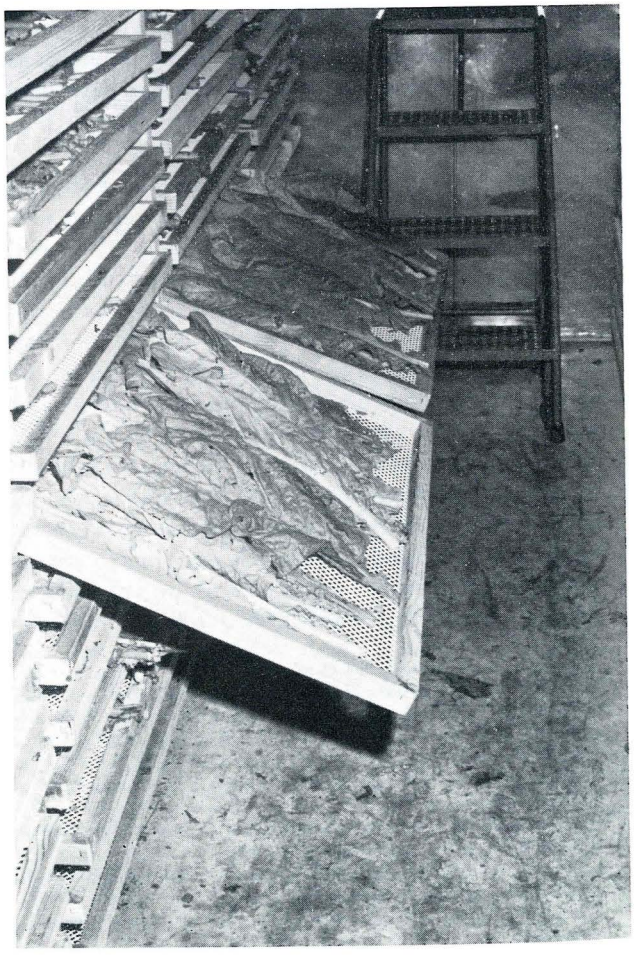


Figure 2. Tobacco plot, showing field-yellowing of upper leaves with ethephon (Ethrel) (120 mg/plant).

The photograph illustrates the yellow condition of treated rows of plants sprayed three days previously, as compared to untreated rows of plants intended for barn-curing.

Incubating

After homogenization, the slurry was incubated at 50° C for 15 min by tumbling in the vacuum dryer without evacuating the system.

Drying

Dehydration was achieved by means of a 283-liter Stokes double-cone rotary evaporator* (Fig. 4). A vacuum of 76 cm of Hg was attained with a high-capacity Stokes Microvac pump, running continuously with ballast open. Temperature in the hot-water jacket around the evaporator was maintained at 80° C with a 12-kW circulator-heater. Water vapor removed from the rotating drum was condensed and collected in the reservoir of a Stokes vertical-tube condenser. Cooling water in the condenser was held at 28–30° C. The evaporator drum was rotated at a speed of 6 rpm. Maximum rate of water removal was 12.5 kg/h. Batches consisting of about 225 kg were completely dehydrated in about 18 hours. The first six batches harvested from lowermost stalk positions were removed at about 20% moisture and spread out on a flat surface to air-dry under ambient conditions 3–5 days before being dried to completion in the evaporator. In trial runs, tobacco slurry tended to stick to the sides of the evaporator drum, thereby restricting heat exchange. The addition of cylindrical blocks of hardwood with the slurry eliminated this problem by preventing the formation of insulating layers of dried tobacco. Each batch of cured tobacco initially was kept separate for chemical analyses before they were mixed together for sheet reconstitution.

Analytical Methods

All samples were thoroughly dried, milled, and stored in moisture-proof packets before use. Total alkaloids

* Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U. S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

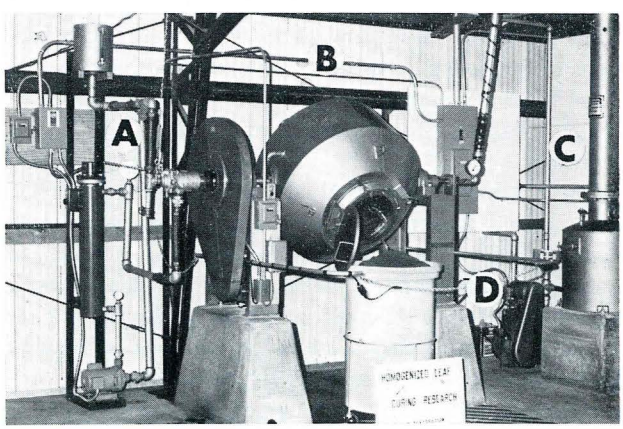
Figure 3. Extrusion food chopper (1/2 H.P. U.S. Berkel brand with 2.5-mm mesh sieve), used for homogenizing whole leaves.

1 g sodium metabisulfite per 450 g leaves was added during homogenization. Tobacco slurry was stored and transported in mobile polyethylene barrels.

and reducing sugar determinations were made by the Tobacco Analytical Service at N. C. State University, Raleigh. Starch content was determined by the iodine stain method described by *Gaines* and *Meudt* (5). Chlorogenic acid and rutin were measured by the method of *Sheen* (15).

Figure 4. General view of vacuum-drying equipment used for incubation and dehydration of homogenized leaf slurry.

The system consisted of a Stokes-Pennwalt double-cone rotary evaporator with the following major components: [A] Water heater and circulator, Model 600-12 E, [B] Drying drum, 283-liter capacity, Model 159-2, [C] Vertical-tube surface condenser, Model 85, BS and [D] Microvac high-vacuum pump, Model 146H.



Conductivity and pH values were obtained from tobacco samples subjected to 2-min sonication with a Branson Model W.40 D sonifier. A 1-g portion of cured tobacco was suspended in 50 ml deionized water. Conductivity was determined with a Chemtrix type 70 meter, and pH readings were taken with a Corning Model 12 meter.

Protein was extracted in tris-HCl buffer, 0.1 N at pH 7.8 containing 1 mM EDTA, 10 mM $MgCl_2$, and 5 mM dithiothreitol. A 1-g portion of milled tobacco was homogenized in 20 ml of buffer with a Virtis # 60 at 40,000 rpm for 30 sec. The homogenate was centrifuged at 20,000 × gravity and filtered through Miracloth to remove floating debris. The supernatant fluid was combined 1 : 1 with 20% cold trichloroacetic acid, and the resulting pellet was redissolved in 0.1 N NaOH. The protein in this preparation was estimated with the Folin reagent by the method of *Lowry* et al. (10).

Ammonia was measured by the *Wasilewski* procedure following the recommendations of *Nikolin* et al. (13) for tobacco.

RESULTS

Vacuum-drying was adopted as a method for removing moisture from homogenized tobacco leaves after several years of experimentation with thin-sheet drying in an ambient-air stream or hot-air drying in a tumbler (22). Slow drying in an ambient-air stream resulted in two major problems: [1] Development of molds and [2] loss of 90% of the sugar content. The mold problem was solved by the addition of 5% ethyl alcohol to the slurry. Accelerated drying with hot air prevented loss of sugars but resulted in a product having an objectionable odor and poor color. Partially yellowed leaves yielded a green product, whereas overripe leaves yielded a dark-brown product. Preliminary tests with drying in a vacuum oven demonstrated that vacuum dehydration corrected the disagreeable odor and color caused by air-drying. Sugar levels in vacuum-dried tobacco were found also to be in an acceptable range.

In interpreting the chemical data presented in Tables 1, 2, 3, and 4, it should be noted that the batch numbers for HLC tobacco primed from lower and middle portions of the plant correspond to progressively higher stalk positions; thus, Batch # 1 represents tobacco taken from the ground level — leaves commonly termed "lugs". Batches of upper-leaf material were from sections of the field successively "yellowed" with ethephon. Because experimental details differed somewhat with various batches, the batches cannot be regarded as replicates.

Table 1 shows total alkaloids in vacuum-dried HLC tobacco and flue-cured tobacco from comparable stalk positions. The concentration of nicotine tended to increase from the bottom to the top of the plant in both types of material. Alkaloid levels were slightly higher in HLC samples from lower leaves but somewhat lower in upper-leaf samples. Polyphenol levels (chlorogenic acid and rutin) were generally lower in HLC

Table 1. Alkaloid and phenolic constituents in comparable homogenized leaf and flue-cured bright tobacco.

Curing method (Stalk position)	Batch	Total alkaloids (% dry weight)	Polyphenols	
			Chlorogenic acid (% dry weight)	Rutin (% dry weight)
HLC				
Lower*	# 1 (lugs)	0.83	1.01	0.05
	# 2	1.02	1.31	0.25
	# 3	1.16	1.79	0.31
	# 4**	1.37	1.59	0.30
	# 5	1.29	1.87	0.12
	# 6	1.23	1.53	0.27
Average		1.21	1.62	0.25
Middle	# 7	1.61	1.42	0.42
	# 8	1.48	2.25	0.26
	# 9	1.68	1.71	0.25
	# 10	1.62	1.76	0.44
Average		1.60	1.79	0.34
Upper	# 11	1.69	1.92	0.43
	# 12	1.66	1.84	0.39
	# 13	1.91	1.71	0.35
	# 14	1.90	2.01	0.65
	# 15	1.94	2.18	0.51
Average		1.82	1.93	0.47
Upper	# 16***	2.35	1.31	0.16
Flue-cured				
Lower	# 17	0.81	1.72	0.15
Middle	# 18	1.57	2.15	0.52
Upper	# 19	2.55	2.01	0.63

* Slurry allowed to incubate at approximately 20 % moisture for several days before final drying.

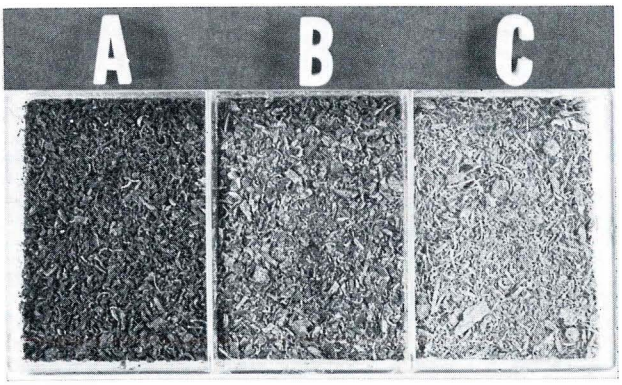
** Composed of overripe tobacco.

*** Homogenized in blender at 55° C.

tobacco (Table 1). All lower-leaf material had somewhat lesser sugar levels than subsequent batches obtained from midstalk position, even though the two sets of samples were visually similar (Table 2). Reducing sugars were exceptionally low in Batch # 4 (i.e. 1.2%). It should be pointed out that Batch # 4 was overripe when processed, after having been conditioned in the ethylene room for 5 days instead of the usual 3-day period. It was also vacuum-dried at a lower temperature (50° C) than the other batches and removed from the evaporator when still very wet. The resultant product was much darker than the other comparable batches processed from leaves harvested from the lower one-third of the plant (Fig. 5). Batches # 1 through 6 were all subjected to open-air drying after reaching 20% moisture. Reducing sugars were 10% or higher in the batches subjected to rapid drying, with the exception of Batches # 11 and # 16. Highest sugar levels were found in leaves harvested from midstalk positions. The average sugar value for Batches # 7, 8, 9, and 10 was 15.2%, which was slightly less than the value of

Figure 5. Samples of tobacco prepared by HLC process, showing variation in color.

[A] dark extreme, Batch # 4, [B] composite, Batches # 2—15, except # 4, [C] light extreme, Batch # 16.



17% for Batch # 18, a comparable barn-cured sample. Batch # 16, with only 8.7% sugar, was a notable exception. This material was macerated with a blender instead of the food chopper. During blending, the temperature rose to 55° C, which might have inactivated some hydrolytic enzyme activity. However, this treatment did result in a bright golden-yellow product, lighter in appearance than other HLC samples (Fig. 5). Incomplete conversion of starch to sugar was apparent in all HLC samples, because starch levels were 2—3 times higher in HLC tobacco than in comparable barn-cured material (Table 2).

Analyses of ionic properties of HLC and barn-cured tobacco showed that electroconductivity readings were lowest in upper-leaf extracts of both types (Table 3). According to *Shmuk* (16), low values are associated with superior quality, because electroconductivity is an expression of the combined organic acid and ash content of tobacco. In terms of total acidity, an inverse relationship was observed between HLC and barn-cured tobacco. As shown in Table 3, the lowest pH values were found in upper-leaf samples of HLC tobacco and in lower-leaf samples of barn-cured tobacco. These figures indicated that a relatively shorter drying time during HLC processing resulted in a higher organic acid content.

A high protein residue in cured leaves is considered detrimental to tobacco quality. During normal tobacco curing, enzymic proteolysis results in breakdown of

Table 2. Carbohydrate constituents in comparable homogenized leaf and flue-cured bright tobacco.

Curing method (Stalk position)	Batch	Reducing sugars (% dry weight)	Starch (% dry weight)
HLC			
Lower*	# 1 (lugs)	7.9	1.43
	# 2	4.7	5.41
	# 3	6.0	4.94
	# 4**	1.2	5.03
	# 5	8.3	2.66
	# 6	10.0	3.05
Average		6.0	4.22
Middle	# 7	16.6	2.11
	# 8	15.2	5.94
	# 9	16.0	3.86
	# 10	12.9	5.22
Average		15.2	4.28
Upper	# 11	9.2	7.41
	# 12	10.7	7.31
	# 13	11.6	4.62
	# 14	10.7	4.05
	# 15	10.7	5.64
Average		10.6	5.81
Upper	# 16***	8.7	3.87
Flue-cured			
Lower	# 17	14.8	1.23
Middle	# 18	17.0	2.95
Upper	# 19	13.4	1.59

Table 3. Ionic properties of comparable homogenized leaf and flue-cured bright tobacco.

Curing method (Stalk position)	Batch	Electro-conductivity (milli-siemens/cm)	Acidity (pH)
HLC			
Lower*	# 1 (lugs)	3.75	6.32
	# 2	3.00	6.77
	# 3	2.65	5.45
	# 4**	3.15	7.43
	# 5	2.65	4.91
	# 6	2.60	4.94
Average		2.81	5.90
Middle	# 7	2.50	5.03
	# 8	2.10	4.98
	# 9	2.10	4.96
	# 10	1.99	5.09
Average		2.17	5.02
Upper	# 11	1.60	4.86
	# 12	1.65	4.83
	# 13	1.70	4.86
	# 14	1.78	4.87
	# 15	1.85	4.89
Average		1.72	4.86
Upper	# 16***	1.75	4.80
Flue-cured			
Lower	# 17	2.90	5.08
Middle	# 18	1.90	5.16
Upper	# 19	1.70	5.28

* Slurry allowed to incubate at approximately 20 % moisture for several days before final drying.

** Composed of overripe tobacco. *** Homogenized in blender at 55° C.

Table 4. Protein and ammonia levels in comparable homogenized leaf and flue-cured bright tobacco.

Curing method (Stalk position)	Batch	Protein (% dry weight)	Ammonia (% dry weight)
HLC			
Lower*	# 1 (lugs)	1.61	0.077
	# 2	1.73	0.087
	# 3	1.71	0.072
	# 4**	3.22	0.173
	# 5	2.09	0.066
	# 6	2.45	0.063
Average		2.24	0.092
Middle	# 7	2.56	0.038
	# 8	2.15	0.044
	# 9	2.33	0.053
	# 10	2.19	0.041
Average		2.31	0.044
Upper	# 11	1.86	0.043
	# 12	2.27	0.040
	# 13	1.99	0.040
	# 14	1.64	0.037
	# 15	1.99	0.038
Average		1.95	0.040
Upper	# 16***	1.78	0.045
Flue-cured			
Lower	# 17	2.13	0.016
Middle	# 18	3.42	0.006
Upper	# 19	3.72	0.016

* Slurry allowed to incubate at approximately 20 % moisture for several days before final drying.

** Composed of overripe tobacco.

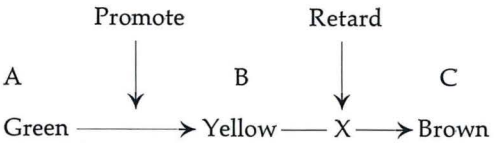
*** Homogenized in blender at 55° C.

leaf proteins to amino acids and ammonia. As shown in Table 4, the process of HLC resulted in substantially lower protein levels than did flue-curing. The only exception to this was Batch # 4, which had other inferior characteristics previously discussed. In general, low protein was associated with high ammonia — a reflection of the derivation of ammonia from protein hydrolysis.

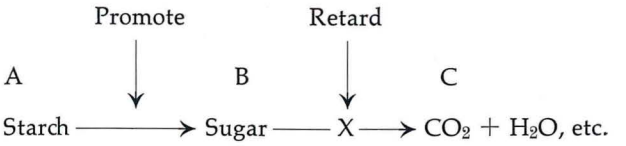
DISCUSSION

The purpose of conventional curing of bright tobacco is to "fix" the chemical composition of the leaf at a specific stage of senescence, resulting in the arrest of biochemical reactions in the leaf at an intermediate stage by means of sequential increments of heat (19). As *Akehurst* (1) has pointed out, raw tobacco of poor quality cannot be improved by good curing practices. During the curing phase, degradation of chlorophyll results in exposing the yellow carotenes; concomitantly, most of the starch is enzymatically hydrolyzed to sugars, and leaf protein is digested by proteolytic enzymes. If these biochemical changes are not terminated properly, further deleterious changes occur, such as the loss of sugars by respiration and oxidative browning by polyphenols. The two major reactions that must be controlled are the following:

1. Color changes



2. Carbohydrate conversions



In each of the above reactions, the change of A to B must be promoted, whereas the change of B to C must be retarded. Most of the conversion of starch to sugar occurs during the yellowing phase of flue-curing (2). When HLC tobacco is dehydrated under vacuum, the reactions required for chlorophyll and starch hydrolyses were favored over the oxidative reactions that cause sugar losses and browning. The data also suggest that protein degradation is promoted by HLC processing. Judging from results obtained with Batch # 4, the combined effects of delayed processing and prolonged incubation in the presence of air are detrimental to maintaining good tobacco quality with the HLC system. The problem of incomplete starch hydrolysis observed with all HLC tobacco will probably require some adjustments in the conditions of incubation.

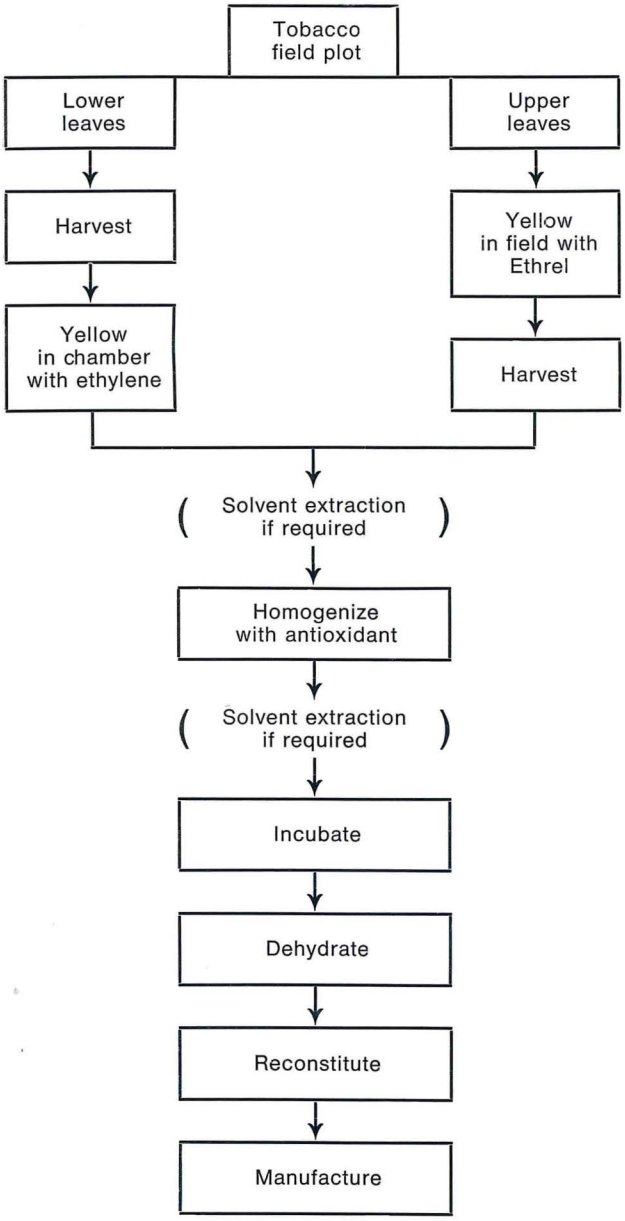
A proposed sequence of operations for HLC processing is provided in the flow diagram of Fig. 6. The dual-harvest system can be applied to varieties such as C-319, which do not ripen uniformly in response to ethephon (Ethrel).

Because homogenization results in a rapid mixing of enzymes and substrates, biochemical reactions might be expected to be initially accelerated. However, exposure to oxygen also increases, and unless oxidative processes are controlled, adverse chemical interactions occur. For this reason, addition of an antioxidant during homogenization and the use of vacuum for dehydration have proved to be beneficial in HLC. Some objection might be raised to the use of metabisulfite as an antioxidant. Although the total sulfur content is about doubled (unpublished results), no increases in SO_2 levels have been detected in the smoke from HLC tobacco as compared to flue-cured tobacco (22).

Although tobacco processed by the HLC method had a somewhat unpleasant odor when first removed from the evaporator, the unpleasantness disappeared with time as the tobacco aged. Whether further improvements in aroma would result from aging at higher moisture

Figure 6. Projected flow diagram of HLC process.

Solvent extraction was not included in these experiments, but it could be inserted if considered desirable. Methods for sheet reconstitution and subsequent manufacture into cigarettes are presently being evaluated.



levels or under conditions favoring mild fermentation should be examined.

Up until now, a prime consideration has been to produce a tobacco with attributes of flue-cured tobacco, but it should be stressed that the HLC method can easily be modified in any number of ways to obtain a product considerably different from flue-cured tobacco. Modern concepts of tobacco quality must take into account the imperative for producing a safer cigarette acceptable to the consuming public. *Tso* (20) has discussed possibilities for manipulating the biochemical properties of tobacco through agronomic practices and suggested that, in the future, tobacco could be predesigned for desirable smoke properties. The options available for removing undesirable substances from tobacco during conventional flue-curing are severely limited. The HLC process, on the other hand, provides excellent opportunities for chemical extractions and additions before, during, and even after curing. Incubation conditions before drying could also be readily modified, if necessary. Because several different methods are already commercially available for sheet reconstitution (12), a wide range of possibilities exists for altering the smoke properties of HLC tobacco.

Many practical advantages favor the HLC process. By appropriate management, such as varietal selection, low topping, and chemical ripening, it seems feasible to machine-harvest HLC tobacco in a once-over operation. Accelerated drying of HLC tobacco enables the curing schedule to be shortened considerably. Furthermore, integration of HLC with sheet-making could result in complete automation of the entire process. In view of recent developments with non-tobacco smoking substitutes (14), a departure from traditional practices for tobacco production seems justifiable as well as necessary. Future projections are that the two most formidable challenges in tobacco agriculture will continue to focus on scarcity of manual labor and the alleged health hazards of smoking. Homogenized leaf curing might provide a means for simultaneously solving both problems (21). As data are collected on the biological activity of HLC tobacco prepared under various conditions, the process can be modified as needed.

CONCLUSIONS

Bright tobacco of acceptable quality and suitable for reconstitution into sheet was produced by a novel process, termed homogenized leaf curing (HLC). Present indications are that, to prepare bright tobacco by HLC, certain precautions are required:

1. The tobacco must be *initially yellowed* in the field with ethephon or in ethylene-ripening chambers immediately after harvest, before homogenization of the leaf tissue.
2. Addition of an *antioxidant* at the time of homogenization is necessary to prevent oxidative browning. One gram per 450 g tobacco of sodium metabisulfite, a potent polyphenoloxidase inhibitor, was found to be satisfactory for this purpose.
3. The *incubation* step must be long enough to allow chlorophyll degradation and sufficient conversion of starch to sugar. Elevation of temperature during incubation should not exceed 55° C, but supplementary aeration is not necessary.
4. The *dehydration* step can be satisfactorily accomplished with a rotary evaporator under at least 76 cm of Hg vacuum. Decreasing the oxygen tension by vacuum allows hydrolytic reactions to proceed but suppresses deleterious oxidative reactions.
5. Tobacco produced by the HLC method can be *stored* at very low moisture levels in compact containers, which facilitates handling and discourages the

development of molds. No remoistening or redrying is necessary, because the tobacco needs not be threshed. In the pulverized form, HLC tobacco is ready for reconstitution into sheet.

Although, it is anticipated that increasing HLC production from a pilot-plant to a commercial scale will require numerous adjustments and modifications, a number of practical advantages in handling and usability of the product are already apparent.

SUMMARY

A method has been developed for curing bright tobacco in a macerated state. The process, termed homogenized leaf curing (HLC), represents a radical departure from conventional barn curing. Leaves are yellowed chemically with ripening agents rather than with heat before homogenization. An antioxidant is added at the time of homogenization to prevent oxidative browning. The tobacco slurry is incubated briefly at an elevated temperature, and then the water is removed under vacuum. The cured product is golden-brown in color and has an innocuous odor that dissipates with age. Alkaloid levels are not significantly different, but sugars are generally lower and starch is higher in HLC tobacco than in barn-cured controls. Advantages of the HLC process over conventional curing methods are: [1] capability for more complete mechanization in premanufacturing stages of production and [2] enhanced potential for modification of tobacco so as to eliminate substances found to be hazardous to health.

ZUSAMMENFASSUNG

Für die Trocknung von „Bright"-Tabak in mazeriertem Zustand wurde ein Verfahren entwickelt, das sich „homogenized leaf curing" (HLC) nennt und eine radikale Abkehr von der herkömmlichen Trocknung im Trockenschuppen darstellt. Die Blätter werden vor der Homogenisierung mit chemischen Reifungszusätzen anstelle von Wärme gegilbt. Zur Verhinderung der Oxydationsbräune wird während der Homogenisierung ein Antioxidans zugesetzt. Nach kurzer Inkubation bei erhöhter Temperatur wird dem Tabakbrei das Wasser unter Vakuum entzogen. Das getrocknete Produkt hat eine goldbraune Färbung und einen harmlosen Geruch, der mit der Zeit vergeht. In nach dem HLC-Verfahren behandeltem Tabak ist der Zuckergehalt im allgemeinen niedriger und der Gehalt an Stärke höher als in im Schuppen getrockneten Kontrolltabaken; die Gehalte an Alkaloiden unterscheiden sich hingegen nicht wesentlich voneinander. Das neue HLC-Verfahren weist gegenüber den herkömmlichen Trocknungsmethoden folgende Vorteile auf: [1] vollständigere Mechanisierung der vor der technischen Verarbeitung liegenden Produktionsstufen und [2] bessere Möglichkeit zur Veränderung des Tabaks mit dem Ziel der Beseitigung gesundheitsgefährdender Substanzen.

RESUME

On a développé une méthode pour sécher le tabac «bright» sous forme de macération. Le procédé appelé «séchage de feuilles homogénéisées / homogenized leaf curing» (HLC), quitte radicalement les méthodes conventionnelles de séchage. Avant homogénéisation, les feuilles sont jaunies chimiquement à l'aide d'agents mûrissants plutôt que par la chaleur. Pour éviter un brunissement par oxydation, on ajoute un antioxydant au moment de l'homogénéisation. La boue de tabac est incubée brièvement à haute température, et l'eau est extraite sous vide. Le produit sec a une couleur brun doré et une odeur non nocive qui se dissipe au vieillissement. Les teneurs en alcaloïdes ne diffèrent pas de façon significative, par contre la teneur en sucre est généralement plus basse et la teneur en amidon plus élevée dans le procédé HLC que dans le tabac séché de façon habituelle. Les avantages du procédé HLC par rapport aux méthodes conventionnelles sont: [1] possibilités d'une mécanisation plus complète dans le stade de préparation de la production et [2] une meilleure possibilité de modification du tabac afin d'éliminer les substances nocives à la santé.

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