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High-Energy Electron-Beam Processing of Tobacco*

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INTRODUCTION

More than ten years ago *Boenig* et al. (1, 2) investigated the application of gamma irradiation with a cobalt-60 source to cigarettes prior to smoking. In these studies continued by *Severson* et al. in 1975 (3), it was found that the smoke of irradiated cigarettes contains less condensate and similar components and also fewer free radicals than their respective non-irradiated controls. *Severson* et al. remarked that gamma irradiation of cigarettes has no major effects on smoke composition.

The present report is an extension of the work of *Severson* et al. (3) in that it includes not only studies on tobacco smoke composition but also those involving physical and chemical changes occurring in the tobacco itself rather than the finished cigarette.

The irradiation of organic compounds may result in a variety of chemical changes brought about by ionization, free radical formation, chain reactions and the like. These transformations include hydrolysis, oxidation, halogenation, nitration, decarboxylation, polymerization, degradation and the like depending on the compound or compounds irradiated and the conditions of irradiation (4, 5). The reactions do not always follow the lines which would be predictable on thermo-chemical grounds and this renders the field of radiation chemistry especially interesting. Reactions in complex or natural environs (such as tobacco) are not completely predictable due to the presence of possible accelerators and/or quenchers of the irradiation effects (6).

In addition to the chemical effects induced by high-energy or ionizing radiation, physical and biological effects are also encountered (7, 8, 9). These include sterilization of microbial species, expansion of cell walls due to gas release, and appearance of fluorescence.

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EXPERIMENTAL

Radiation Source and Conditions

In the present studies, the radiation source was a high-speed electron accelerator, the Dynamitron II, manufactured and operated by Radiation Dynamics of Plainview, N.Y. In all experiments the unit was operated at 3 million volts and 20 milliamperes. Under these conditions and for single-sided irradiation, the effective penetration depth for an electron is about 0.5 inches in water or 12 inches in air. The dose or delivered energy in all cases is expressed as megarads (Mrad), where one Mrad is equal to 10^8 ergs of energy deposited per gram of material. The unit was operated in such a way as to deliver 2 Mrads per pass. To ensure nearly uniform dose throughout, the samples were turned often during multiple exposure so that there was irradiation on both sides of the container.

In all cases, irradiation of the sample was carried out in sealed, low-density polyethylene bags [2 mils (.051 mm) thickness]. The purpose of this shield was to prevent ozone interaction with tobacco. (It is well known that ozone is produced from oxygen within the exposure chamber (7).) In this way, the effects of ozonization were kept to a minimum and would only occur as a result of ozone formed from air trapped inside the bag. For some samples even this latter ozone formation was entirely eliminated by flushing the contents of the bag with nitrogen prior to sealing. Ozone generated outside of the bag did not penetrate but preferentially reacted at the surface of the polyethylene (10).

In order to establish a desired level of radiation exposure for the tobacco, an initial sample was exposed to 10 Mrads by multiple passes. Visual inspection of the sample did not show evidence of gross changes. Irradiation was continued until a total of 50 Mrads had been delivered, at which point there was no question that the

sample had been altered. Therefore, levels no higher than 50 Mrads were used throughout these studies. This is comparable to the maximum levels used by *Severson* et al. during their studies (3).

Tobacco and Cigarette Source

Fully cured, high-quality, whole leaf Virginia Bright tobacco was used in these studies. The leaf was not destemmed prior to irradiation. Chemical tests (Series 1 and 2, Table 1) were carried out on materials ground to approximately minus 100 mesh in a Wiley mill, while physical tests and observations were performed on unground material.

Smoke analyses were performed only on materials exposed to 50 Mrads (Series 2, Table 1). In this case it was found that the whole leaf could not be handled conventionally for the production of cigarettes even after humidification. For this reason, irradiated and non-irradiated materials were ground and made into reconstituted tobacco sheets by the Microflake® slurry process (11, 12). After shredding to 32 cuts/inch, the shreds were converted to cigarettes on an AMF Chico Model CCM maker.

ANALYTICAL PROCEDURES

All solubility measurements were made using Soxhlet extractors with an extraction time of 16 hours. The tobaccos were between 9 and 12 % in moisture; however, corrections were made so all values are reported on a dry weight basis. The pre-dried flasks, which contain condensate, were taken to near dryness on heating mantles then placed in an oven at 105 °F (40.6 °C) for 6 hours before weighing.

Reducing sugars were extracted using a procedure employing methanol, acetic acid and charcoal (13). The determination step was reduction of ferricyanide and then a titration with ceric sulfate to the ortho-phenanthroline ferrous sulfate end point (14). The procedure was modified so that the final tobacco aliquot taken for titration contained 2.0 ml of methanol and 0.5 ml of acetic acid. This condition was found to give reproducible results and recoveries of 100 ± 2 % for dextrose added to samples.

Pectin is reported as percent d-α-galacturonic acid. The tobacco was pre-extracted with 95 % ethanol to remove sugars and then refluxed with ammonium oxalate to solubilize the pectin. The resulting solution was analyzed via the colorimetric carbazole method described by *McComb* and *McCready* (15).

Procedures for dextrin, crude fiber, tannin, crude lignin and cellulose were the standard methods used for tobacco analysis as outlined by *Raymond* (16).

The nicotine content of tobacco and of the particulate matter from combustion of the cigarettes was determined by a standard steam distillation, ultraviolet absorbance method, as in *Horwitz* (17).

Cigarettes were conditioned for 72 hours at 60 % relative humidity and 70 °F (21.1 °C) before being selected for weight and pressure drop. One group of non-filtered, 85 mm, irradiated and one exactly matching group of non-irradiated cigarettes were used. The cigarettes were smoked on a piston-type smoking machine fitted with solenoid valves and adjusted to take a 35 cm^3 puff of 2.0 seconds duration once a minute. Total particulate matter (TPM) was determined by the Cambridge filter method of *Ogg* (18). Water content of the TPM was determined by gas chromatography after extraction of the Cambridge pads in isopropylalcohol (column: 6′×1/8″ stainless steel, Chromosorb 101, operated isothermally at 110 °C). These results were used to calculate the Federal Trade Commission (FTC) condensate values shown. (TPM minus water minus nicotine equals FTC condensates.)

A measured portion of the isopropylalcohol solutions used for the water analyses was analyzed for phenols. The solution was acidified with hydrochloric acid then steam distilled. Phenols were assayed using the method of *Oakley* (19) with the following modifications: [a] freshly boiled distilled water was used in the steam generation kettle, [b] an all-glass system was used for steam generation, and [c] the analytical procedure was carried out in such a way that the total phenol content of each aliquot did not exceed 775 μg. Using these modifications and collecting 250 ml of distillate, recoveries in the range of 100 ± 4 % for known quantities of added phenol were obtained.

Gas phase from machine-smoked cigarettes was collected in teflon-lined bags adapted with Roberts clamp-on valves. Carbon monoxide and carbon dioxide contents of gas phase were determined by an infrared analytical procedure. Isoprene, acetaldehyde, acetone, and acrolein were determined by gas chromatography, using a 24′×1/4″ stainless steel column packed with 10 % Carbowax 600 on 80/100 mesh Chromosorb W which was acid washed. The column was operated isothermally at 65 °C. Retention times were: 7.35, 11.11, 16.64 and 18.69 minutes, respectively.

RESULTS AND DISCUSSION

Two separate batches of Virginia Bright whole-leaf tobacco were irradiated during the present studies as indicated in Table 1. In the first series, the tobacco was divided into seven groups. One group served as the unirradiated control. Three groups were irradiated in an air atmosphere and three in a nitrogen atmosphere at

Table 1. Virginia Bright whole-leaf tobacco prepared for the current studies.

	Irradiation (Mrad)		
	Control	Air	Nitrogen
First series	0	10	10
		25	25
		50	50
Second series	0	50	

radiation levels of 10, 25 and 50 Mrads. Examination of the tobacco after 50 Mrads irradiation indicated a drying of the tobacco, a discoloration or browning (which reportedly (6) can be induced by ionizing radiation), an expansion or puffing of the midrib stems, extreme fragility, and an obvious deterioration in the aroma characteristics. The tobacco stems were so weakened that they could be reduced to a fine powder simply by rolling them between the fingers. The sample irradiated to 25 Mrads had an obvious change in its aroma, and drying of the tobacco was apparent. The stems were brittle and broke like dry twigs when put under stress but did not crumble to dust. The sample irradiated to 10 Mrads was changed in aroma, but the stems were neither dry nor brittle. They were merely soft or spongy to the touch. Samples irradiated under nitrogen appeared to be the same as those irradiated in air. Because of this, air was used as the atmosphere for all the tobacco irradiated in the second series at 50 Mrads. The purpose of this second series was to provide a large sample, produced under a condition that resulted in an obvious and substantial effect, for conversion into cigarettes and subsequent chemical analysis of the smoke as well as for selected chemical analysis of the tobacco itself.

Coolidge (20) had reported that "when a portion of the leaf of a rubber plant is rayed (cathodic) with 1 milliampere for as long as 20 seconds, the rayed area becomes immediately covered with white latex, as though the cell walls had, in some way, been ruptured". Puffing of tobacco under ionizing radiation is therefore not unexpected. However, the extreme ease with which the tobacco stems exposed to 50 Mrads would disintegrate to dust prompted further study of the physical changes induced. Therefore a cross-section of a 50 Mrad irradiated sample of midrib was examined microscopically and compared with cross-sections of freeze-dried and puffed tobacco samples prepared from the same lot of tobacco. The freeze-dried sample was prepared by Dr. W. *Johnson* of North Carolina State University. The puffed sample was prepared in our laboratories in accordance with a patented process (21). Only the midrib section of the leaf was examined in all cases because of the ease of sample preparation and since the effects were more visually obvious than with lamina.

Photomicrographs are presented in Figure 1. The unirradiated control shows the normal configuration of cells in the tobacco stem. In the freeze-dried sample, cellular expansion occurs outside the xylem region and, as expected, no cellular rupture is evident. The puffed

Figure 1. Comparative cross-sections of tobacco midribs (magnification: 45 ×).

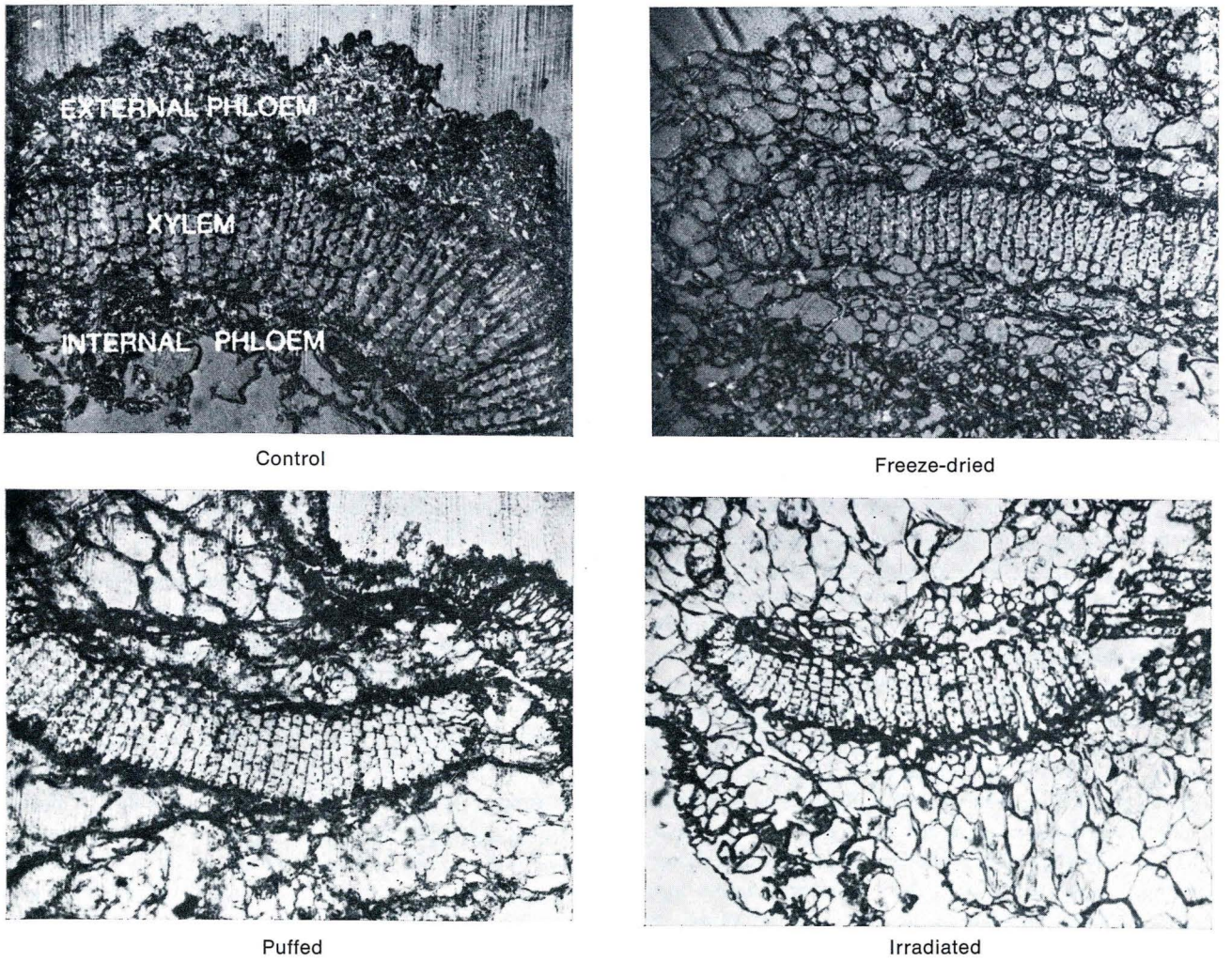
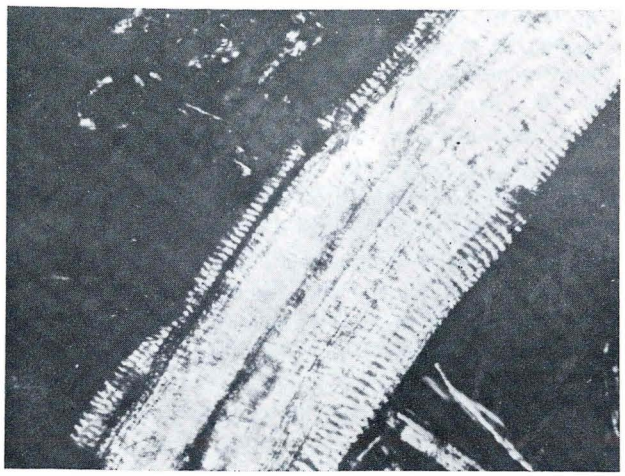
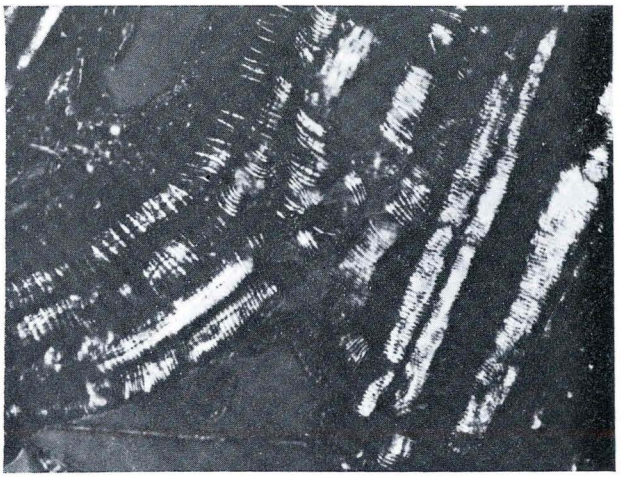


Figure 2. Tobacco stem (midrib) cellulose (magnification: 200 × – polarized light).



Control



Irradiated (50 Mrad)

sample, on the other hand, shows evidence of cellular expansion *and* rupture, again outside the xylem region. Cellular rupture is not unexpected in this sample and is probably due to sudden vaporization of the imbibed volatile solvent (Freon 11) upon exposure to microwave energy. Neither the freeze-dried nor the puffed materials were fragile and they could not be disintegrated under mild pressure. They both retained a certain amount of elasticity.

With the irradiated sample there is cellular expansion outside of the xylem, with practically no rupture of the cell walls. This is most likely due to the simultaneous depolymerization of the cell wall constituents which renders the cell much more elastic and therefore susceptible to expansion without rupture and the release of water vapor and other gases generated by the heat build-up in the sample from the high flux irradiation. Inspection of the xylem of this sample shows cellular disorder whereas the other samples do not show this phenomenon. It is felt that this disorder, caused by penetration of the xylem with energetic electrons and their localized release of energy, is responsible for the extreme fragility of the sample.

Even though the photographs in Figure 1 are quite demonstrative of the physical effects induced by radiation on tobacco, the full dramatic impact of the disruptive effect is not fully appreciated until one inspects Figure 2. The photomicrographs in this figure were taken using polarized light. In this way only birefringent material is seen and this is invariably associated with crystalline structure or molecular orientation as is found in cellulose fibers. In the photographs, the background appears black and the cellulosic material appears white. The control represents a sample of untreated stem that has been taken through a cellulose isolation scheme (22). The other sample is one of an irradiated stem that has *not* been taken through the same scheme. Since the irradiated stem was so fragile, in order to preserve integrity as much as possible, it was photographed by merely suspending it in water. This is the reason why *more* non-birefringent material is evident in this photograph. Inspection of the photographs shows the typical spiral or helical formation of tobacco stems. In the case of the control, spiral segments are well ordered and in close proximity to one another. For the irradiated sample, one gets the impression that the sample has been "blown" apart – the spiral coils look like springs that have been stretched and deformed. The bundles of cellulose fibers have been shattered, broken, separated and the well-defined order between the rows of coils is gone. This feature is accompanied by a depolymerization of cellulose and pectin. Chemical evidence in support of this statement is discussed below. It is this deformation that probably accounts for the extreme fragility of the sample.

The first series of seven samples was prepared for chemical analysis by separating the lamina from the stem after irradiation. Only the lamina portions were examined for chemical differences.

In Table 2 quantitative data are listed for the extractives of lamina with several non-polar and moderately polar solvents. The data in brackets are for the tobacco irradiated in a nitrogen atmosphere; the rest of the data are for tobacco exposed in an air atmosphere. The trend with hexane is similar for both the air and nitrogen irradiated samples and in every case the amount of extractives has decreased compared to the control. This indicates that at least some materials, usually soluble in this solvent, such as lipids, sterols, terpenes and waxes,

Table 2. Extractives of lamina with selected solvents.

Solvent	% by weight			
	Control	Irradiated tobacco		
		10 Mrad	25 Mrad	50 Mrad
Hexane	8.1	7.4 (6.2)	5.1 (5.5)	5.5 (5.5)
Chloroform	13.7	10.7	9.2	10.8
Hexane-ethanol azeotrope	17.8	16.3	14.5	16.6
Acetone	26.2	22.6	25.3	19.5

( ) = Values for irradiation in nitrogen.

Table 3. Extractives of lamina with polar solvents.

Solvent	% by weight			
	Control	Irradiated tobacco		
		10 Mrad	25 Mrad	50 Mrad
Methanol	43.4	45.5	48.7	48.4
80 % ethanol	47.5	50.9 (51.3)	49.9 (48.4)	46.3 (49.3)
Water	44.8	46.8 (46.7)	54.7 (47.3)	61.4 (63.5)

( ) = Values for irradiation in nitrogen.

have been modified by irradiation. The decreased amount of extractives for the irradiated samples versus the control is obvious with each solvent shown, but there is no clear trend among the irradiated samples themselves which can be related to dosage level. This general effect of decreases in the amount extractable with these relatively non-polar solvents could be due to an oxidative mechanism which would likely produce fairly polar degradation products.

In Table 3 the results of extraction studies with polar solvents on the same test samples are presented. In these cases the data show that irradiation has increased the amount of extractives. For water, the increase appears to be related to dosage level. At the 50 Mrad level, the quantity of extractives has been increased by 40 %. This large increase must be caused by degradation and fragmentation of polymeric chains. For the other solvents shown, no clear trend in extractability versus dosage level is apparent and there were no significant differences for samples irradiated in air versus those irradiated in nitrogen.

Data are presented in Table 4 for nicotine, reducing sugars, dextrin and cellulose levels in control and irradiated samples. In the case of irradiation in air, nicotine content was progressively reduced as dose increased. For the 50 Mrad sample, nicotine content of both leaf and stem was reduced by 65 and 60 %, respectively. With the sample irradiated under nitrogen, nicotine reduction was not as severe; reduction at 50 Mrads was 35 %.

Table 4. Selected chemical analyses of lamina and stem components.

	% by weight			
	Control	Irradiated tobacco		
		10 Mrad	25 Mrad	50 Mrad
Nicotine:				
1. Lamina	3.03	1.95 (2.49)	1.60 (1.87)	1.06 (1.97)
2. Stem	0.96			0.38
Reducing sugars*	15.26	21.78 (19.72)	21.32 (18.55)	16.98 (17.71)
Dextrin*	3.84	6.90	7.94 (5.10)	9.02 (5.58)
Cellulose*	12.19	9.77 (10.24)	10.12 (10.54)	6.79 (7.21)

* = Lamina only. ( ) = Values for irradiation in nitrogen.

The reducing sugars were found to be significantly increased at the 10 Mrad exposure level in both air and nitrogen. This is likely the result of degradation of starch or cellulose to glucose. However, further irradiation resulted in progressive decreases in the reducing sugar content. The mechanisms involved have not been studied here, but the literature concerning irradiation and thermal degradation of cellulose indicates that glucose yields are affected by the presence of "impurities" in the cellulose. It is clear that the cellulose environment in tobacco is very complex. Therefore glucose yields from irradiation of tobacco would not be predictable.

The dextrin content of the irradiated samples increased as the dose increased. The increase was greater for the samples irradiated in air than for those irradiated in nitrogen. Dextrin is a water-soluble polysaccharide obtained from starch. The dextrin analysis is made on tobacco residue after sugars have been extracted with 80 % ethanol. Then, the cold-water soluble fraction is taken, hydrolyzed to glucose and analyzed as reducing sugar. Therefore by this scheme, any low molecular weight fragments produced by irradiation of either starch or cellulose, which are water-soluble but not soluble in 80 % ethanol, will analyze as dextrin. These fragments would then account for the increased values found for dextrin in the irradiated samples.

Cellulose content in tobacco was radically changed by the high-energy electrons, especially at the 50 Mrad level where there was approximately a 40 % reduction. Results were essentially the same in air and in nitrogen. This reduction is not surprising in light of the drastic physical changes observed visually and previously shown in Figures 1 and 2.

Since pectin is present in the cell walls of all plant tissues and is known to function in combination with cellulosic material as an intercellular cementing substance, the large reduction in cellulose content prompted us to investigate pectin contents. These data are presented in Table 5. At a dose of 50 Mrad, total pectin was found to be reduced by about 25 %. In view of the cellulose data and the physical changes observed in the samples, a larger reduction in pectin content had been expected.

Table 5. Pectin content of tobacco lamina.

	% by weight as galacturonic acid			
	Control	Irradiated tobacco		
		10 Mrad	25 Mrad	50 Mrad
TOTAL PECTIN				
Air	9.42	7.98	8.07	7.24
(Nitrogen)	(9.42)	(8.49)	(8.27)	(6.52)
LOW MOLECULAR WEIGHT PECTIN				
Air	1.78	2.44	3.63	4.23
(Nitrogen)	(1.78)	(2.49)	(3.24)	(4.12)

Table 6. Whole leaf tobacco analyses after 50 Mrad irradiation.

	% by weight		% Change
	Control	50 Mrad	
Cellulose (semi-quant.)	12.43	3.28	−74
Crude fiber	13.09	5.12	−61
Solubility in 80 % EtOH	38.1	38.8	+2
Solubility in H_2O	49.2	65.2	+33
Dextrin	2.32	6.48	+180
Total Pectin*	15.42	14.38	−7
Tannin	2.56	1.14	−55
Crude lignin	5.29	6.82	+29
Reducing sugars	12.53	10.82	−13
Nicotine: leaf	1.60	1.19	−26
Nicotine: stem	0.42	0.26	−38

* As galacturonic acid.

However, it should be remembered that the pectin analysis depends on hydrolysis of pectin to galacturonic acid and subsequent determination of the latter. In fact, pectin data is expressed as percent by weight galacturonic acid. The total pectin method, therefore, does not differentiate between polymerized and depolymerized pectin and the data therefore can be somewhat misleading. Consequently, a second analysis was performed and is presented in Table 5 as "low molecular weight pectin". This analysis involves the precipitation and removal of high molecular weight pectins with calcium ions, followed by analysis of the remaining and soluble low molecular weight pectins, as galacturonic acid. Inspection of Table 5 reveals the substantial increase in this fraction as the irradiation dosage increases indicating a high degree of pectin depolymerization.

The second series of Virginia Bright whole leaf tobacco was prepared as indicated in Table 1. Since the irradiated tobacco could not be handled conventionally, the whole leaf was converted by the Microflake® process to reconstituted tobacco sheet prior to cigarette manufacture. The unirradiated control was handled in the same manner. In this section, therefore, selected chemical analyses of tobacco were performed on ground whole leaf rather than on either lamina or stem as in Series 1.

Selected chemical analysis data are presented in Table 6 and indicate the following changes due to irradiation:

1. The cellulose and crude fiber contents were drastically reduced (approximately 60 %).
2. There was an increase in the amount of extractables in polar solvents, especially in water (approximately 30 %).
3. The dextrin content was very substantially increased.
4. Total pectins were slightly decreased. Analysis for "low molecular weight" pectins previously described was not performed. However, there was evidence of depolymerization from the observation that pectin isolated from the irradiated sample did not gel in an acidified acetone medium.

Table 7. Smoke analyses — particulate phase.

	Yields (mg/cigarette)		% Change
	Control	50 Mrad	
No. of puffs / cigarette	6	6	0
Total particulate matter	32.7	36.9	+12
Nicotine	1.31	0.90	−31
Nicotine-free dry particulate matter	27.8	30.6	+10
Colorimetric phenols*	76	97	+27

* Phenols are expressed as µg/cigarette.

5. Tannins or polyphenols and lignin were also examined on this sample. The tannins were found to be significantly reduced while the lignin was somewhat increased.
6. Reducing sugars were found to be slightly decreased in this second series.
7. The nicotine values were reduced to about the same level as in the first series, but the percentage reduction was not as large.

In Table 7 are listed the results obtained on the particulate phase of cigarettes made from tobacco irradiated to 50 Mrads and aliquots made from unirradiated control tobacco. The cigarettes were 85 mm non-filter. They were smoked to a 23 mm butt length on a piston-type smoking machine using a 35 cm^3 puff for 2 seconds duration taken once every minute. Total particulate matter and FTC condensate (nicotine-free dry particulate matter) were slightly higher for the irradiated sample. These findings differ from those previously reported (1, 2, 3). Nicotine was found to be considerably reduced as previously reported (3). Colorimetric phenols were increased in the irradiated sample but burn rate remained unchanged.

Table 8 shows the results of several selected gas phase analyses made on these same cigarettes. The data indicate that for these components, there were no significant changes between the two samples and confirm the data previously obtained by *Severson* et al. (3).

CONCLUSION

High-energy electron-beam irradiation of tobacco produces profound physical and chemical changes, particularly at the 50 Mrad level. However, an examination of the smoke constituents of cigarettes made from irradiated and unirradiated tobacco forces the conclusion that irradiation has no major effects on the composition of the gas phase and only minor effects on the composition of the particulate phase. An exception to this was a rather large reduction in nicotine content. These features are in accord with the findings of *Severson* et al. (3) but are somewhat surprising in view of the profound chemical changes found in the tobacco itself.

Table 8. Smoke analyses — gas phase.

Compound	Yield (mg/cigarette)	
	Control	50 Mrad
Isoprene	0.99	1.00
Acetaldehyde	0.30	0.33
Acetone	0.16	0.15
Acrolein	0.06	0.05
Carbon monoxide	6.7	7.3
Carbon dioxide	23.4	21.9

SUMMARY

While it is known that ionizing radiation can bring about chemical, biological and physical changes in organic tissue, relatively little is known concerning radiation effects on tobacco and its combustion products. In an effort to study such changes, Virginia Bright tobacco was exposed to ionizing radiation at doses up to 50 Mrads, generated electronically by a high-voltage discharge. It was found that tobacco exposed to this high radiation will undergo physical changes such as a darkening, an increase in brittleness, puffing of the stems and a change in aroma characteristics. Chemical changes were found in selected chemical components such as water and solvent solubles, nicotine, reducing sugars, dextrin, cellulose, pectin, tannins and lignin. Both physical and chemical changes seem to be dose dependent. Studies on smoke components from cigarettes of both irradiated and non-irradiated tobacco indicate that irradiation had no major effects on the components of the gas phase examined and only minor effects on the composition of the particulate phase.

ZUSAMMENFASSUNG

Es ist bekannt, daß ionisierende Strahlen in organischem Gewebe chemische, biologische und physikalische Veränderungen hervorrufen können, verhältnismäßig wenig weiß man hingegen über die Wirkung von Strahlen auf Tabak und seine Verbrennungsprodukte. Zur Untersuchung solcher Veränderungen wurde Virginiatabak (Bright) ionisierenden Strahlen, die elektronisch durch hochvoltige Entladungen erzeugt wurden, in Dosen von bis zu 50 Mrad ausgesetzt. Tabak, der mit solch hohen Strahlendosen behandelt worden war, zeigte physikalische Veränderungen wie Dunkelfärbung, Zunahme der Sprödigkeit, Anschwellen der Rippen und eine Änderung des charakteristischen Aromas. Chemische Veränderungen wurden bei einzelnen chemischen Komponenten beobachtet wie den wasser- und lösungsmittellöslichen Inhaltsstoffen, dem Nikotin, den reduzierenden Zuckern, dem Dextrin, der Cellulose, dem Pektin, den Tanninen und dem Lignin. Sowohl die physikalischen als auch die chemischen Veränderungen scheinen von der Strahlendosis abhängig zu sein. Die Untersuchung der Zusammensetzung des Rauches von Cigaretten aus bestrahltem und unbestrahltem Tabak zeigte, daß die Bestrahlung auf die Bestandteile der Gasphase keinen größeren Einfluß ausübt und die Inhaltsstoffe der Partikelphase nur geringfügig beeinflußt werden.

RÉSUMÉ

On sait que les radiations ionisantes peuvent provoquer des changements d'ordre chimique, biologique et physique dans les tissus organiques. Par contre, on connaît relativement peu de chose concernant l'effet des radiations sur le tabac et ses produits de combustion. Dans le but d'étudier ces changements, du tabac de Virginie (Bright) a été exposé à des radiations ionisantes produites électroniquement par des décharges à haut voltage, en doses atteignant 50 Mrads. Le tabac exposé à des radiations d'une telle intensité a subi des changements physiques tels que coloration plus foncée, friabilité accrue, expansion des côtes et modification des caractéristiques de l'arôme. Des changements d'ordre chimique ont été observés dans certains composants chimiques spécifiques tels que l'extrait aqueux, l'extrait lipophile, la nicotine, les sucres réducteurs, la dextrine, la cellulose, la pectine, les tannins et la lignine. Les changements d'ordre physique aussi bien que ceux d'ordre chimique semblent dépendre de la dose des radiations. L'examen de la composition de la fumée de cigarettes faites de tabac irradié et non irradié indique que l'irradiation n'a pas d'influence significative sur les composants de la phase gazeuse et seulement une influence insignifiante sur la composition de la phase particulaire.

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