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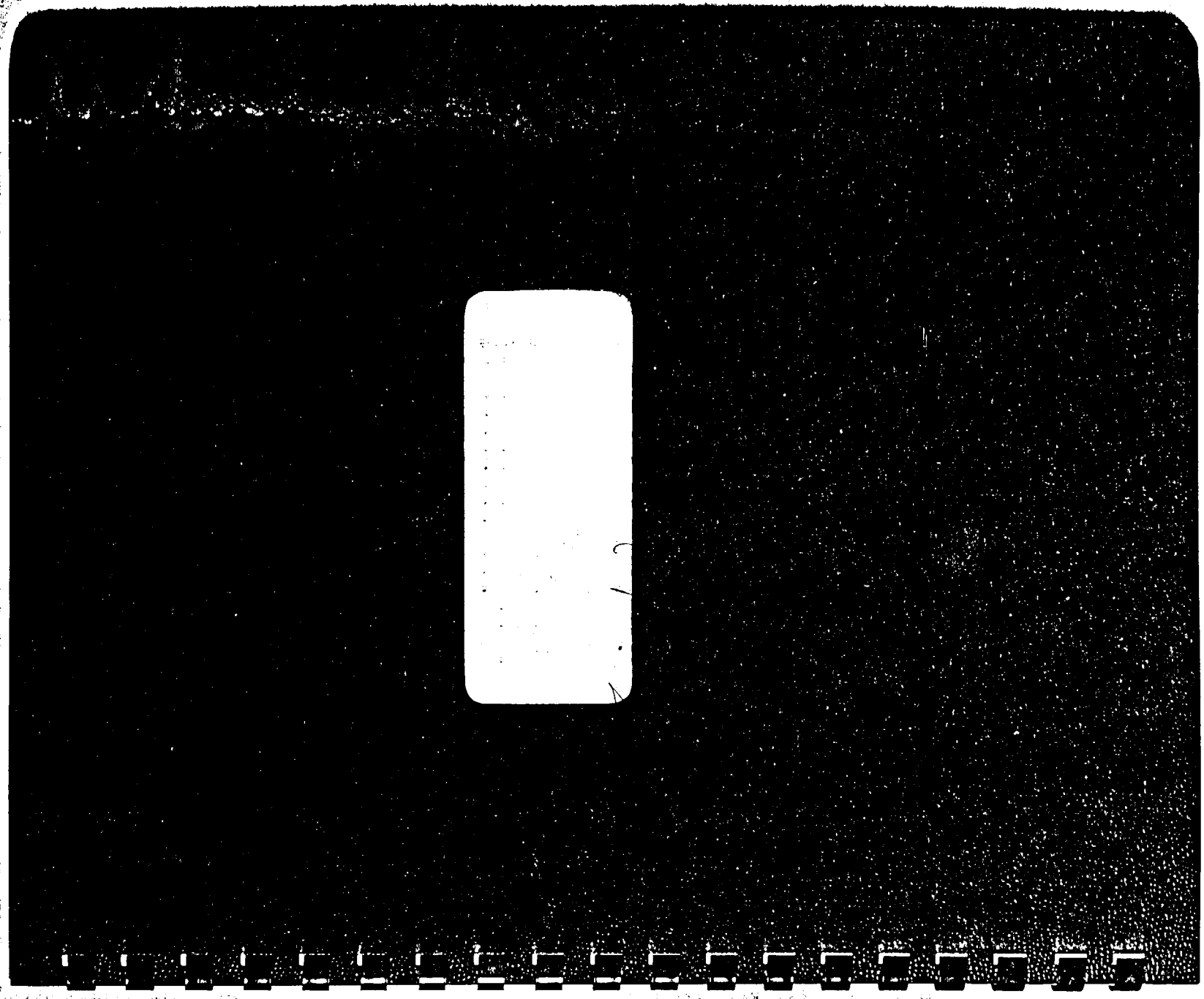

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ABSTRACT

The original VP and National Panel results on Reaction Flavored RL 393 and 420 showed that these RLs were acceptable substitutes for 150-B RL and ES in the 78-1 and 79-1 Marlboro blends. Flavor production was scaled up to a 20 gallon reactor from 1 liter and 12 liter lab scale. New panel tests have been requested for Marlboro, Merit and B&H models. Stability tests have begun on the storage of Reaction Flavors along with isolation and identification studies of flavor constituents. Alternate sources of amino acids are being investigated.

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I. Objective

The main objective is to develop Reaction Flavors which modify RL subjectives to allow higher utilization of RL in the blends. Along with the work on sheet materials, Reaction Flavors are being considered as an improver for off-shore stems and tobacco as well as flavors for low delivery cigarettes.

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II. Introduction

Reaction Flavor refers to the Maillard Reaction or non-enzymatic browning process. Reaction Flavors are generated by reaction of a sugar and an amino group. The amino group is usually from ammonia or an amino acid.

Reaction Flavors are natural products used as flavorants in many products in the food industry. Natural meat flavor, nut flavors and chocolate flavors are areas where Maillard reactions are being used. The sulfur amino acids in meat are responsible for most of the cooked meat flavors. Therefore, the particular sulfur amino acids are reacted with sugars to produce an acceptable meat flavor. The same type of logic can be applied to tobacco since Reaction Flavor products are generated in tobacco during curing, aging, and processing.

III. Materials

In our reaction mixtures we use sugars, amino acids, ammonia and carbonyl compounds. The carbonyl compounds are added because carbonyls found in tobacco are very important in the flavor of tobacco.

IV. Experimental and Results

A. Initial Work.

The first reaction flavors were generated in the lab in a one liter glass flask using an oil bath for heating. Flavors found to be successful by injection into 20% unflavored RL Marlboros were then sprayed on RL in semi-works. The sprayed RL's were made into Marlboros replacing the RL-150B and RCB. The flavors that still looked promising after spraying were then incorporated into the CEL of the RL process. Reaction Flavors were added to the final sheet at the 1% or .3% solids basis level. Some of the promising

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Reaction Flavors were then scaled up to a 12 liter batch size in the lab. RL sheet was also made with these 12 liter remake flavors. The 12 liter batch size was found to be subjectively comparable to the 1 liter batch size of Reaction Flavor. The two Reaction Flavored RL's of most interest are 393 RL and 420 RL. In addition to 1% flavor addition, these sheets contained sorbate and 1% TEG.

Table 1 Reaction Flavored RL's

393 - Original

420 - 40% reduction in aldehyde from 393

430 - 12 liter flavor batch size remake of 420 flavor

On VP and POL tests last year, the RL's performed well in 78-1 and 79-1 Marlboro models[1-4]. In these panel tests, the eaction lavored RL's replaced the RL-150B and ES. The major significant results are listed in Table 2.

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Table 2 Summary of Panel Results

Test cigarettes - test RL's replaced RL-150B and ES

393 RL

V-3781 - 78-1 Marlboro

C - tendency for higher overall acceptability rating (CP)

POL-3069 - 79-1 Marlboro

T - Preferred (CP)
More flavor (CP)
More satisfying (CP)
Better aftertaste (CP)

420 RL and 430 RL

V-3785 - 78-1 Marlboro

T - Higher overall acceptability rating (CP)
Less harsh (CP)

POL-3076 - 79-1 Marlboro

T - Preferred (FFS)
More strength (CP)
Less mild (CP)
More flavor (FFS)
More satisfying (FFS)
Better aroma (FFS)

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The panel results indicate that the 393 RL and 420-430 RL's are an improvement over the RL 150B + ES combination.

B. Scale Up.

Due to the promising results on the mailout panels of 393 RL and 420 RL, a 20 gallon, stainless steel, pilot plant reactor was purchased and installed late last year in C pilot plant. A study of heating rates was conducted to produce conditions in the 20 gallon reactor similar to the 1 liter lab reactions

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(Figure 1). After the 20 gallon reactor conditions had been established, 393 (7396-113) and 420 (3796-114) flavors were prepared and added to the CEL at the 1% level of 563 RL and 564 RL, respectively. The RL's were then incorporated into a 79-1 Marlboro blend replacing the RL-150B and ES. Screening by Flavor Development personnel showed that the 563 RL and 564 RL were comparable to 393 RL and 420 RL. The new RL's are to be used in mailout panel tests.

C. New Panel Tests.

Three series of tests have been requested using 563 RL and 564 RL. National panels using a 78-4, 85mm Marlboro control and a 81-1, 85mm Marlboro with the RL replaced with 563 RL and 564 RL test cigarettes are N-3120 and N-3122, respectively. Since the Reaction Flavored RL's have not been tested in any brand but Marlboro; Merit and B&H Virginia Panels have been requested. In both cases, a 78-4 cigarette is the control and a 81-1 cigarette with the 563 RL and 564 RL are the test cigarettes as follows:

Test	Model	RL
V-4753	Merit	563
V-4754	Merit	564
V-6597	B&H	563
V-6580	B&H	564

To date, none of the panel test cigarettes have been made.

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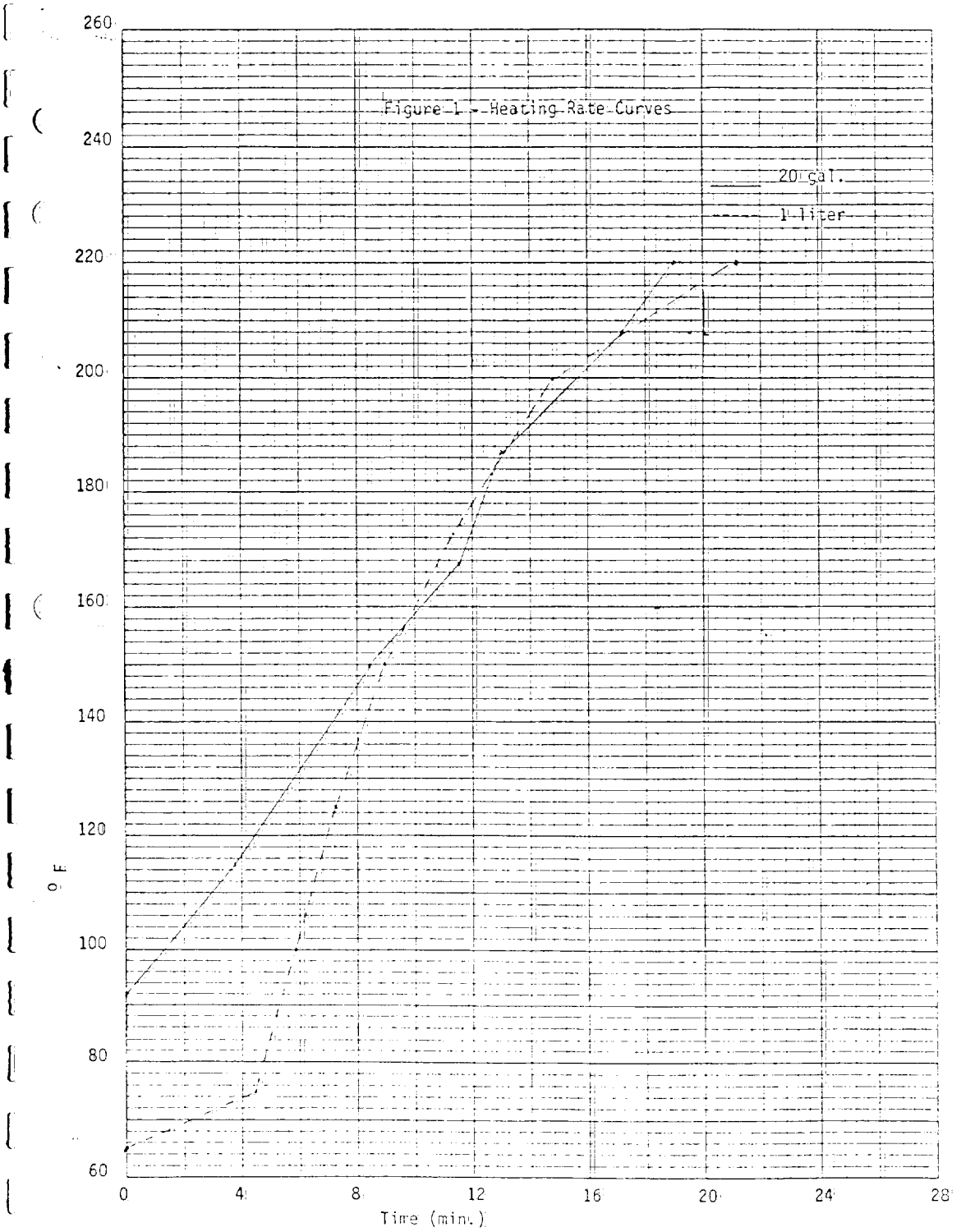

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D. Storage Study.

The flavors (7396-113 and 7396-114) made in the 20 gallon reactor were divided into two lots. One lot of each flavor was stored in a Cold Room and at room temperature. For the first month, a sample was taken each week from each flavor at both conditions and analyzed for sugar and amino acid content. No significant changes were found. Therefore, the sampling period was increased to every two weeks. To date, no significant changes have been noted. This data is listed below in Tables 3 and 4.

Table 3 — Storage Study

Fructose Analysis (~ 7% error)

	Room Temp.		Cold Room	
Wk	113	114	113	114
0	17.9	16.7	16.9	17.5
1	17.5	17.5	16.9	17.6
2	16.5	16.6	16.4	16.5
3	17.2	17.3	17.2	17.6
5	17.4	17.3	17.1	17.5
7	17.5	17.4	17.8	18.3

Table 4 — Storage Study

Amino Acid Analysis (~ 9.4% error)

	Room Temp.		Cold Room	
Wk	113	114	113	114
0	1.9	1.7	1.7	1.9
1	2.5	2.6	2.6	2.8
2	2.6	2.7	2.6	2.8
3	2.6	2.7	2.7	2.8
5	2.4	2.6	2.6	2.7
7	2.4	2.6	2.6	2.6

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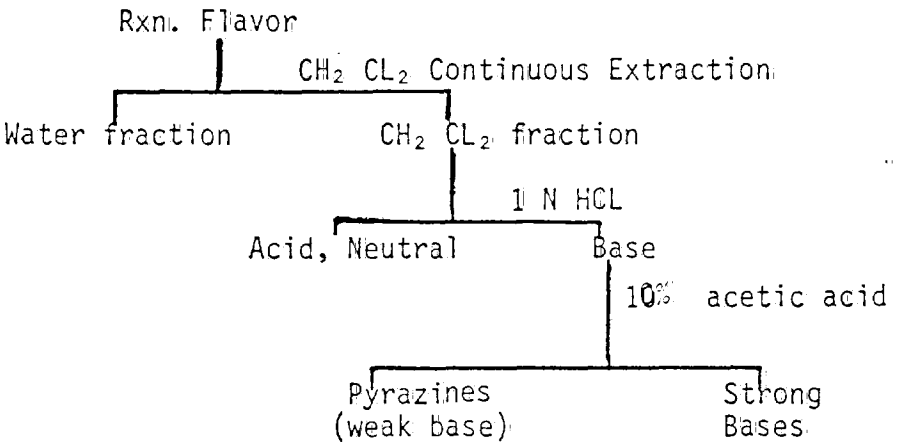
E. Identification Study.

To be able to better understand Reaction Flavors, a program to identify the products was initiated. The pyrazine fraction was the first to be studied. Using the 420 RL flavor formulation, the organic fraction was separated by using methylene chloride in a continuous extractor for 24 hours. The pyrazines were isolated using the following acid-base scheme.

Figure 2 Pyrazine isolation scheme



Using GC-MS and capillary GC, 5 pyrazines were identified and their ratio to each other measured.

Table 5. Pyrazines Identified

Pyrazine	Ratio
Methy	10
2,6-Dimethyl	5
2,3-Dimethyl	1
2,5-Dimethyl	1
Trimethyl	trace

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The other pyrazines discovered have not been identified. Further work on identification of reaction products is being done in conjunction with Dr. Kallianos and Ms. Barbara Joyner.

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F. Alternate Amino Acid Sources.

Yeast have been used as flavorants in the brewing and baking industry. A program was begun to use yeast as an amino acid source for Reaction Flavors. This differs from using pure amino acid as one gets a mixture of amino acids. The use of yeast necessitates extra steps to the reaction flavor process due to the hydrolysis of yeast proteins. Favorable results have been obtained using Brewer's yeast and Baker's yeast. The hydrolysis time and Reaction Flavor conditions have been studied. The resultant flavors have been added to RL sheet at the 1% level.

Table 6. Yeast Reaction Flavored RL's

Description	RL
Brewer's (short hydrolysis) + sugar	431
Brewer's + suger + aldehyde	437
Brewer's + sugar	452
Baker's + sugar	453

SEF booth panel tests have shown that the yeast Reaction Flavored RL's may be an acceptable alternative for the 150B RL-ES combination in the 78-1 Marlboro. However, these results are still preliminary.

Table 7. SEF Booth Panel Results

1) 78-1 Marlboro vs. 150B RL and ES replaced with 437 RL
   NSD
2) 78-1 Marlboro vs. 150B RL and ES replaced with 431 RL
   - control had more total taste (< .09)
3) 78-1 Marlboro with 452 RL vs. 453 RL
   453 RL - higher overall acceptability (< .07)
   less harsh (< .11)

Another source of yeast is the FTR biomass from the Nino program. Preliminary results from injection of the Reaction Flavors on 20% unflavored RL Marlboro type cigarettes shows promise.

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V. Plans

As well as continuing work on the programs already mentioned, several new areas are being investigated for the generation and use of Reaction Flavors. A study has been planned for production yield maintenance with the RL replacing ES because of the lower amount of additives in the Reaction Flavored RL sheet. Addition of other bulking agents to the low additive Reaction Flavored RL sheets are to be studied. Also, the use of Reaction Flavors in the Diet process in conjunction with the use of Reaction Flavors in low delivery cigarettes will be evaluated.

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