Experiment 6. Effect of Paint Odors on Beef Flavor. The stored meat consisted of U. S. Choice steer as in the previous experiments. The source of odor contamination for each room consisted of 6 square feet of freshly painted cardboard surface. An oil paint was used.

Taste tests were carried out after 1 day of storage.

Experiment 7. Effect of Odors from Onions on Butter Flavor. The stored butter consisted of four 4-ounce blocks of salt butter placed in each room. The source of odor contamination for each room consisted of two 9 × 13 × 2 inch trays of sliced onions.

Taste tests were carried out after 1 day of storage.

Experiment 8. Effect of Odors of Cantaloupe on Butter Flavor. The stored butter consisted of 4 ounce blocks as in the previous experiment. The source of odor contamination for each room consisted of three fresh ripe cantaloupes sliced into eighths and placed on glass trays.

Taste tests were carried out after 1 day of storage.

Experiment 9. Experiment 3 was repeated with one variation—no odor source was placed in the control room.

Experiment 10. Experiment 8 was repeated with one variation—no odor source was placed in the control room.

Experiment 11. Storage Odors. Odors in the control room caused by the contaminants used in Experiments 1 to 8 were all moderately intense and objectionable to most observers. The corresponding odor levels in the carbon room were near or below threshold values. A panel test of storage room odors, using the contaminants of Experiment 1, showed an unequivocal recognition of the odor in the control room.

Procedure

Screen air purification and blower units
Blindfold subject
Enter carbon room
Leave
Remove blindfold
Enter control or carbon room } Order random and unknown to observer
Enter carbon or control room }
Judge which room subject smelled when blindfolded

Results

Correct judgments, 20
Incorrect judgments, 0
Per cent correct, 100
Confidence limit for significance, 0.002%

Discussion

The taste scores and their statistical analysis presented in Table II show highly significant differences in meat and butter flavor due to removal of atmospheric odors. The sources of odor contamination selected were intended to duplicate contaminants likely to be present in commercial food storage, where different varieties of food may be stored together, unnoticed food scraps may decompose in inaccessible parts of the room, and, in rare instances, a new or used storage box may be painted or oiled. Odors from such sources will contaminate food flavor to a degree that depends on the prevailing odor intensity in the storage space and the duration of food storage in the odorous atmosphere. Food flavor contamination by atmospheric odors is not practically significant when the odor concentration is below threshold. Thus the positive removal of odor in a food storage space is, for all practical purposes, equivalent to the effective elimination of flavor adulteration by air-borne organic vapors. This was shown by the results of experiments 9 and 10, in which the panel members failed to distinguish between food stored under air purification in a contaminated room and equivalent food stored alone in a clean room.

Taste preferences were overwhelmingly in favor of the uncontaminated foods. Descriptions of the contaminated samples included "flat," "off-taste," "less flavor," "lack of flavor," "meaty," "different," "gamey," "sharp," "odd," "did not like it"—expressions which also, incidentally, reflect the poverty of language for describing chemical senses. Only in experiments 3 and 7 were some members sufficiently acute to describe the butter as "oniony" and the meat as "sour."

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COTTONSEED MEALS

Influence of Processing on Protein Values

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COTTONSEED MEAL has been used as a protein concentrate for farm animals for many years with varying degrees of success. The amount that can be fed to young calves, poultry, and swine is limited because of the gossypol occurring in the resin glands (*1*) of cottonseed, which is not completely converted to the nontoxic bound gossypol (*2, 3, 8, 10*) during processing. The effect of processing conditions on the chemical properties of cottonseed meal was studied and reported by Haddon, Thurber, and associates (*5*).

In 1950 the Protein and Carbohydrate Division of the Southern Regional Research Laboratories, under the direction of Aaron M. Altschul, began a comprehensive study with several state experiment stations to investigate the nutritive value of cottonseed meals, prepared by special processes which would ensure a minimum content of free gossypol and thus render them nontoxic to chickens and swine when fed in liberal quantities. The department of agricultural chemistry of the University of Arkansas undertook the study of the influence of processing on the protein values of cottonseed meals. For this work three types of cottonseed meals were prepared by the Southern Regional Research Laboratories:

Solvent-Extracted Cottonseed Meal. Flaked cottonseed meals were extracted with hexane to remove the lipides and then with butanone (methyl ethyl ketone) containing 3% water to remove the major portion of the gossypol. The extracted meats were heated only sufficiently to remove the residual solvent. The meal contained 55.1% protein and 0.015% free gossypol.

Screw-Press Meal. Meal 1 was cooked

A biological study was made of the protein values of three cottonseed meals and one cottonseed flour, as influenced by different methods of processing, using the albino rat as the experimental animal, with the objective of obtaining a meal of low gossypol content and high biological value. The protein efficiency varied inversely with the amount of heat treatment. The highest and lowest values were obtained with the solvent-extracted meal and the cottonseed flour, which were the least and most drastically heated, respectively. Improvement in the biological value of the proteins in the cottonseed flour on addition of lysine and methionine indicated that they were partially destroyed or made unavailable during processing. The results of these studies may stimulate the commercial production of cottonseed meals and cottonseed flours of higher biological values by modification of methods of processing.

for 25 minutes at a maximum temperature of 200° F. and contained 37% protein and 0.028% free gossypol.

Meal 2 (S-5-1) was cooked for 37 minutes at a maximum temperature of 230° F. It contained 40.4% protein and 0.027% free gossypol.

Cottonseed Flour (commercial product). Cleaned cottonseed meats were rolled to a thickness of 0.007 to 0.010 inch and cooked in a stack cooker at a temperature of about 225° F. for 70 to 100 minutes. The hot cottonseed cakes were further cooked, after the oil had been expressed from the cooked meats by hydraulic presses, and aged for 30 days before grinding. Considerable care was used in removing the hulls, as the product was used for human consumption. It was ground by hammer mills and the fine material was separated from the coarse by air, so that 98% of it would pass through a 200-mesh sieve. The crude protein content was 57%.

Experimental Procedure

This study was carried out on Wistar strain albino rats. Each animal was in an individual metal cage on screens with large enough perforations so that no access to fecal excretions was possible. The animals were about 28 days old and weighed 50 to 52 grams when started on the experiments. There were 24 animals in each group, the sexes being equally represented. Each animal was weighed weekly and accurate weekly records of food consumption were kept. The experimental period was 10 weeks.

The rations contained 2% cellu flour for roughage, 4% of Sure's salt mixture No. 1 (*9*), 8% vegetable shortening, 2% cod liver oil, and 1% wheat germ oil. The cottonseed meals furnished all the proteins in the rations and were fed at 10, 8, and 5% levels of protein intake. The commercial cottonseed flour was fed at the 10% level of protein intake unsupplemented with amino acids and also supplemented with 0.2% L-lysine, 0.2% DL-methionine, and with 0.2% L-lysine and 0.2% DL-methionine in the rations. Vitamins A, D, and E were furnished by the cod liver oil and wheat germ oil in the rations. The following crystalline components of the vitamin B complex were administered daily to each animal separately from the rations six times a week, double doses being given on Saturdays: 25γ each of thiamine, riboflavin, pyridoxine, and niacin; 150γ of calcium pantothenate, 3 mg. of *p*-aminobenzoic acid, 6 mg. of choline chloride, and 1 mg. of inositol. From the gains in body weight per gram of protein intake, the protein efficiency ratios were calculated. The results are summarized in Table I, expressed as average growth per animal during a 10-week experimental period.

Results

It is evident from Table I that at all levels of protein intake the solvent-extracted meal was by far the best product from the standpoint of protein efficiency, undoubtedly because it was prepared without heat treatment aside from that used in the removal of the solvent. The animals fed the commercial cottonseed flour at the 10% level made about half the gains in body weight of those on the solvent-extracted meal, while at the 5% protein level there was an average loss of 0.6 gram for the former as compared to a gain of 43.2 grams for the latter during the 10-week feeding period.

There was no difference between screw-press meals 1 and 2 at the 10% protein level, but at both the 8 and 5% levels No. 1 was superior to No. 2, as indicated by weight gains and protein efficiency ratios. These differences can be attributed to the lower temperature and shorter time at which screw-press meal 1 was cooked.

It is also apparent that the addition of either 0.2% methionine or 0.2% lysine to the ration of cottonseed flour fed at a 10% protein level resulted in increased growth and increased protein utilization, but when the cottonseed flour was supplemented with both lysine and methionine a better growth response and protein efficiency ratio was obtained than with either alone. It is concluded then that in the processing of the cottonseed flour there occurred losses of lysine and methionine or that processing made these amino acids biologically unavailable.

Kuiken and Lyman (*6*, *7*) studied the availability of the essential amino acids in cottonseed flour and samples were processed in various ways and tested by a rat feeding method. The meals were analyzed microbiologically before and after processing. Availability values were lowest for lysine and methionine (64 and 67%, respectively); however, corresponding values of 88% were obtained with special solvent-extracted and

Table I. Influence of Processing on Efficiency of Proteins in Various Cottonseed Meals

Cottonseed Meals	Protein in Ration, %	Weight Gains, G.	Mortality, %	Total Food Intake, G.	Protein Intake, G.	G. Gain/G. Protein Intake
Solvent-extracted	10	144.5	..	864.9	86.5	1.67 ± 0.07[a]
Screw-press No. 1	10	105.7	..	876.0	87.6	1.21 ± 0.05
Screw-press No. 2	10	106.3	..	821.6	82.2	1.30 ± 0.05
Cottonseed flour	10	78.7	..	693.0	69.3	1.13 ± 0.06
Cottonseed flour + 0.2% lysine	10	98.3	..	722.6	72.3	1.36 ± 0.05
Cottonseed flour + 0.2% methionine	10	103.3	..	827.7	82.8	1.25 ± 0.06
Cottonseed flour + 0.2% lysine + 0.2% methionine	10	127.3	..	825.3	82.5	1.54 ± 0.06
Solvent-extracted	8	112.4	..	708.6	56.7	1.99 ± 0.16
Screw-press No. 1	8	85.3	..	676.6	54.2	1.58 ± 0.11
Screw-press No. 2	8	74.3	..	766.6	61.4	1.21 ± 0.06
Cottonseed flour	8	79.6	..	618.5	49.5	1.61 ± 0.11
Solvent-extracted	5	43.2	..	512.2	25.6	1.70 ± 0.15
Screw-press No. 1	5	25.8	..	458.0	22.9	1.13 ± 0.12
Screw-press No. 2	5	21.0	25.0	576.0	28.8	0.73 ± 0.08
Cottonseed flour	5	−0.6	33.3	326.6	16.3	−0.04 ± 0.20

[a] Standard deviation of means.

gland-free meals. These results are in accordance with those reported in this paper.

Summary

A biological study was made of the protein values of three cottonseed meals and one cottonseed flour as influenced by different methods of processing, using the albino rat as the experimental animal. The protein efficiency of these meals and flour was investigated by the rat growth method at 10, 8, and 5% levels of protein intake. The best product from the standpoint of protein efficiency was the one which was solvent-extracted and had no heat treatment. The cottonseed flour which had the most drastic heat treatment showed the poorest protein efficiency. The biological value of the proteins in this product was improved by the addition of lysine and methionine, which had been either partially destroyed or made unavailable during processing.

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AMINO ACIDS
In Cane Juice and Cane Final Molasses

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Cane blackstrap molasses contains as much as 50 to 60% simple sugars. Recovery of these sugars in sucrose production is not economical because of the presence of substances formed from reaction of the sugars with amino acids of sugar cane juice. Chromatographic procedures were applied to this juice and its corresponding molasses to identify the responsible amino acids. Two-dimensional, ascending paper chromatography indicates the probable presence of asparagine, aspartic acid, glutamine, glutamic acid, glycine, alanine, valine, leucine (or isoleucine), serine, tyrosine, and γ-aminobutyric acid in Florida cane juice and (except serine, tyrosine, and glutamine) in its corresponding final molasses.

Cane juice is a major commercial source of sucrose, yet a very significant amount of this sugar remains in blackstrap molasses, a by-product of sucrose production. As a part of the program on the composition of molasses being conducted in this laboratory, assays of cane juice and the final or blackstrap molasses produced therefrom were undertaken to determine their component amino acids, which are considered significant in molasses formation (*16*).

By means of the difficult older isolation techniques, Zerban (*15*) isolated and identified L(*levo*)-asparagine, (*dextro*)-glutamine, and tyrosine in Puerto Rican cane juice. L-Asparagine was the most abundant component. Several other reported demonstrations of amino acid in cane juice, such as that of Maxwell (*9*) for asparagine, cannot be considered experimentally adequate. In Hawaiian cane final molasses, Payne (*10*) reports the presence of aspartic acid, glutamic acid, pyrrolidone carboxylic acid (a probable alteration product of glutamic acid), and lysine. The free amino acid content of Jamaican cane juice (*11*, *13*) and of beet molasses (*6–8*) has been investigated by paper chromatographic methods.

In the present work the authors have devised procedures whereby the amino acid fraction of cane final molasses could be separated sufficiently free of contaminants to enable the use of the techniques of paper chromatography. The amino acid content of the cane juice from which the final molasses originated was determined by essentially the same general methods, in order to learn the fate of these substances in the final cane molasses.

Cane Juice

The unclarified sugar cane crusher juice was collected at Clewiston, Fla., on January 6, 1951. It was quick-frozen, packed in solid carbon dioxide, and transported to Columbus, Ohio, where it arrived still frozen. For partial clarification the thawed juice (200 grams) was poured on a bed of Celite No. 545 (15 grams, Johns-Manville Co., New York, N. Y.) in a jacketed 4-inch Büchner funnel with water at 4° to 6° passing through the jacket. The filtrate was slightly turbid.

Analysis (% original juice). Solids, 14.1; sucrose, 10.7; reducing sugars (as invert sugar), 1.3; pH, 5.7; D_4^{25} 1.052; nitrogen (Kjeldahl), 0.041.

Cane Juice Cations. An amount of 500 grams of partially clarified cane juice was added at the top of a 480 × 32 mm. (diameter) column (dimensions refer to the packing) of Amberlite IR-120 (Rohm & Haas Co., Philadelphia, Pa.) The column was backwashed and washed with distilled water until the effluent was free of sugars. The cane juice cations were recovered from the Amberlite IR-120 with 370 ml. of 10% hydrochloric acid followed by 350 ml. of water. This solution was concentrated under reduced pressure at 48° to 50° to 200 ml. for paper chromatography. Kjeldahl nitrogen was found to be 0.031% (basis original juice; 75% of the nitrogen originally present).

Separation of Amino Acid Fraction of Cane Juice by Fuller's Earth Clay. An amount of 450 grams of partially clarified cane juice was dewatered by ice sublimation; yield was 64.11 grams.