Iranian J. Publ. Hlth.
Spring 1979, Vol. 8,No.1

AIR POLLUTANTS IN FOOD PROCESSING PLANTS IN IRAN*

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ABSTRACT

Investigations have been carried out on the indoor air pollution in different workshops of food processing plants in Iran. In order to evaluate the exposure of workers to the three most commonly used indices of air pollution ten food processing plants representing ten groups of food industry with 2,816 workers were selected. Air borne contamination of different origins such as cotton seed, barly, wheat flour, salt and different spices, sugar and beans dust were measured in 237 work places. Here contamination was 8-9 times higher than the proposed T.L.V. for inert dust in 12% of sampling sites. Carbon monoxide, measured in 94 sampling site in 69 different work places, which was higher than 50 P.P.M. in 13% of samples, and sulfur-bearing air pollutants, determined in 87 different woekshop where 103 samples were collected, showed the existance of oxides of sulfur in 34 samples in six industries. The results are presented and the reasons of the existance of these air pollutants are discussed.

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* This study was supported in part by the funds of the School of Public Health and Institute of Public Health Research, University of Tehran, and in part by the Ministry of Science and Higher Education.

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INTRODUCTION

The term "food industries" covers a whole series of industrial activities directed at the treatment, preparation, conversion, preservation and packing of food stuffs. A large section of the working population and effective force of the combined manufacturing industries of various countries including Iran is employed in food industries.

Apart from health hazards caused by using chemicals which may be irritating, caustic or even toxic, infections or parasitic diseases and contact dermatitis, the majority of occupational ailments in these industries are due to the exposure of the workers to different food-in-air pollutants (3). It has found that workers exposed to different air - borne contaminants which exist in food processing plants, such as vegetable, grain, cereal, tea, sugar and cotton dust, may experience acute mild resporatory distress (Valic, 1972, Sohrag 1972, Nicolls 1970, Uragoda 1970, Zuskin 1975). The effect of Carbon monoxide and oxides of sulfur upon man as the two most used indicis of air pollution are discribed in the literature (Wright 1975, Stewart 1973, Peterson 1972, Lewis 1973, Anderson 1974 and Martin 1972).

The food industries are extremely diverse and the techniques used are as varied as the types of food produced. Therefore the air-borne contaminants depend mostly on the process and materials used in each department. Each time materials are lifted or laid down, piled or unpiled, loaded or unloaded, transported vertically or horizontally from one position or location to another, fed into or removed from a process, placed into or removed from storage, or moved in any way wahtsoever, they produce dust of the same materials used in food processing, as dust of barly and malt, different flours, salt and spices, cotton seed (linter), sugar, cocoa and bean.

Cooking occurs in many manufacturing operations. Drying of the products, distillation and extraction are done by burning carbonaceous matter, mostly oil or oil products in Iran, and whenever a flame touches a surface that is cooler than the ignition temperature of the gassous part of the flame, carbon monoxide may result. Combustion of sulfur bearing coals and petroleum fuels and using sulfur dioxide in refrigeration, bleaching, fumigation and preservation may produce oxides of sulfur in the workroom atmos-

phere.

To investigate the environmental working condition in food processing plants in Iran, an industrial hygiene survey was carried out in order to assess the atmospheric contamination, physical factors of the work environment (7), sanitary conditions and medical safety facilities of the workers in these industries.

In order to investigate the air pollution in different workshops. Air-borne contaminants, Carbon monoxide and sulfur-bearing air pollutants were selected as the indices of air pollution in different workshops of the 10 groups of food processing plants in Iran.

MATERIALS AND METHODS

According to the last Iraian Industrial Statistics there are 1,087 food and drinks processing plants and workshops with 46,712 workers in Iran. In order to evaluate the exposure of workers to various air pollutants, 30 large food processing plants with 7,439 workers were preliminarily surveyed according to their raw materials, processes and products. Then 10 groups of food industries with 2,816 workers were selected by random sampling, which are described in Table 1.

Sampling and determination of air pollutants:

1. Air borne contaminant. Dust was collected on dried preweighed millipore AP-200-5500 glass fibre filters. The samplers were operated at 25-29.5 liters per minute for a period of 45-250 minutes according to dust concentration, the sampling assembly positioned as closed as possible to the main group of the workers in each workshop. After sampling, the filters were dried over silica gel for at least 24 hours before being reweighed, and the mass concentration was calculated as mg of dust per cubic meter of air. (10).

2. Carbon monoxide was measured by using detector tubes (2) (drager 5/C No. CH 25601 and M.S.A. No. 47134) in different workshops at the breathing zones of the workers in each department and as close as possible to the workers.

3. Sulfur-bearing air pollutants were sampled in each workshop using an impinger containing dilute solution of hydrogen peroxide (4). The sampling period varied from 20 to 300 minutes depending upon the concentration of the

Table 1. Characteristics of the food processing industries

Code	Type of plant	Number of Workers			No.of Work-shops	Years of Service
		man	woman	total		
1	Biscuit making	150	500	650	12	18
2	Brewing	68	2	70	8	25
3	Candy-making	195	84	277	14	15
4	Canning	54	126	180	8	13
5	Distilling	110	-	110	8	35
6	Meat packing	62	2	64	6	19
7	Milk Pasteuri-zing	335	5	340	6	19
8	Salt-spice packing	53	6	59	6	27
9	Soft drink making	800	-	800	6	20
10	Vegetable oil-extracting	250	8	264	13	38
	TOTAL	2083	733	2816	87	-

pollutants which changed the colour of absorbing solution.

Results and discussion:

1. Air borne dust was measured in 237 work places and the results are shown in Table 2. Dust concentration in 6 sampling site was more than 12 mg/m^3 and the worst conditions encountered were associated with barly cleaning in the brewery plant, with 22.8 mg/m^3, and salt crashing, in the salt and spice packing plant, with 89.9 mg/m^3. of the 21 sampling sites with dust concentration between 8-12 mg/m^3, malt cleaning and milling departments in the brewery plant, wheat flour packing in the salt and spice packing plant, cotton seed cleaner and crusher in the vegetable oil-extracting plant, cocoa-crushing and refining in the candy-making plant, mechanical bean cleaning in the canned food plant are some of the departments with rather high concentration of dust in the workroom air. 43 samples showed dust concentration between 2-8 mg/m^3, mostly in milk, meat packing and soft drink-making plants.

2. Carbon monoxide concentration. The results of 34 measurements in 69 different workplaces (Table 3) showed that cooking department in the biscuit-making plant with 70 P.P.M. and the 2 bottling departments in the soft drink making plant, with minimum 50 P.P.M. and maximum 200 P.P.M. of carbon monoxide in air, had the highest concentration of carbon monoxide. The furnace in brewery plant, the boiler department in candy-making and cap making area in the soft drink-making plant with 25, 30 and 25 P.P.M. of carbon monoxide in the workroom air were rather polluted workshops. In other workshops the concentration of Co. was less than 10 P.P.M.

3. Sulfur-bearing air pollutants. Sampling and determination of oxides of sulfur-bear carried out in 103 locations of 87 different workshops. Only 34 samples from 6 factories showed the existance of some oxides of sulfure but in 4 plants the green colors of absorbing solution changed to blue instead of red due to the presence of some alkali in the atmosphere. The results are shown in Table 3 and only in the salt and spices packing plant in the dehumidifying of salt did the oxides of sulfur reached 6.2 P.P.M.

In the distillery plant, in which So_2 is dissolved in water for washing the bottles, the level was 1.26 P.P.M. while in other departments the sulfur bearing air pollutants were less than one P.P.M.

The existance of Co. and oxides of sulfur in the work-room air is due primarily to the use of open flames in the workshops, the exhaust of transport trucks and lift trucks inside and near the workshop, and also the heating of the workshops with chimney less oil stoves during the cold seasons.

Conclusion:

There is little published information on the dust level in the barly, salt, cocoa, wheat flour, bean, sugar, cotton seed (linter) industries. But even if we accept all these air borne contaminants that we have found as nuisance dust (biologically inert), 12% of all samples still show high concentration of dust very near or much higher (up to 89.9 mg/m^3 than, the T.L.V. for nuisance dust which is 10 mg/m^3 (12). Further studies of some of these dust with concentration less than 10 mg/m^3 may show some respiratory distress upon workers. (At the present time a study is going on to investigate the health hazards of cotton seed dust on the exposed workers in vegetabl oil-extracting plants which showed 4,9-13.3 mg dust per cubic meter of air).

In 12 different sampling sites Carbon monoxide concentration ranged from 1-4 times the proposed T.L.V. for Co. which is 50 P.P.M. (9). Sulfur-bearing air pollutants existed in 34 sampling sites of 6 industries, one of which was higher than proposed T.L.V. (5 P.P.M. 12), shows the indoor air pollution in food processing plants in Iran. This is mostly because of insufficient control measures such as enclosure, separation, lack of general and local exhaust ventilation and the allowance of bare flames, running diezel engines and oil stoves in the workshops.

Practical and proper recommendation to control the air pollutants in these industries has been given separately for each industry and follow up studies is going on to investigate both the effectiveness of control measure and the effects of the different factors on the health of the exposed workers.

ACKNOWLEDGEMENT

The authors wish to acknowledge with deep appreciation the help and support of Dr. A. Nadim during all phases of this study.

Table 2

Total Dust Concentration in Various Departments of the Food Processing Plants

Code	Type of Plants	Classification of samples regarding T.L.V.					
		No. of Sample	No.of Samples	More 12 mg/m3	8-12 mg/m3		
1	Biscuit-making	12	26	-	-	2	24
2	Brewing	8	16	2	4	2	8
3	Candy-making	14	49	-	2	22	25
4	Canning	8	19	-	2	-	17
5	Distilling	14	34	-	5	7	22
6	Meat-packing	5	12	-	-	2	10
7	Milk pasteurising	6	12	-	-	-	12
8	Salt & spice-packing	6	16	4	4	6	2
9	Soft drink-making	6	22	-	-	-	22
10	Vegetable-oil extracting	13	31	-	4	2	25
	TOTAL	29	237	6	21	43	167
	Percentage	-	-	%3	%9	%18	%70

Table 3. The results of Co and SO_2 Measurements in Various Departments of Food Processing Plants.

Code	Type of Plant	Classification of Samples Regarding T.L.V.										
		Carbon Monoxide T.L.V.=50 P.P.M					Sulfur dioxide T.L.V.= 5PPM					
		No. of sampling sites	No. samples	more than T.L.V.	about 25 PPM	Less than 10 PPM	No. of sampling sites	samples with SO_2	samples without SO2	SO_2 concentration PPM		
										Min.	Max.	Mean
1	Biscuit making	7	8	1	-	7	11	3	9	0.05	0.16	0.11
2	Brewing	7	6	-	1	5	6	6	-	-	-	-
3	Candy-making	6	6	-	1	5	10	6	5	0.001	0.09	0.04
4	Canning	9	12	-	-	12	8	6	3	0.02	0.48	0.15
5	Distilling	13	18	-	-	18	16	10	10	0.02	1.26	0.23
6	Meat packing	4	7	-	-	7	6	-	6	-	-	-
7	Milk pasteurising	4	5	-	-	5	5	-	6	-	-	-
8	Salt-spice packing	9	9	-	-	9	7	7	1	0.02	6.27	0.18
9	Soft drink making	5	17	11	4	22	7	3	8	0.05	0.08	0.06
10	Vegetable-oil extracting	6	6	-	-	6	11	15	-	-	-	-
TOTAL		69	94	12	6	76	87	34	69	-	-	-
PERCENTAGE		-	-	13	6	8%	-	35	67	-	-	-

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