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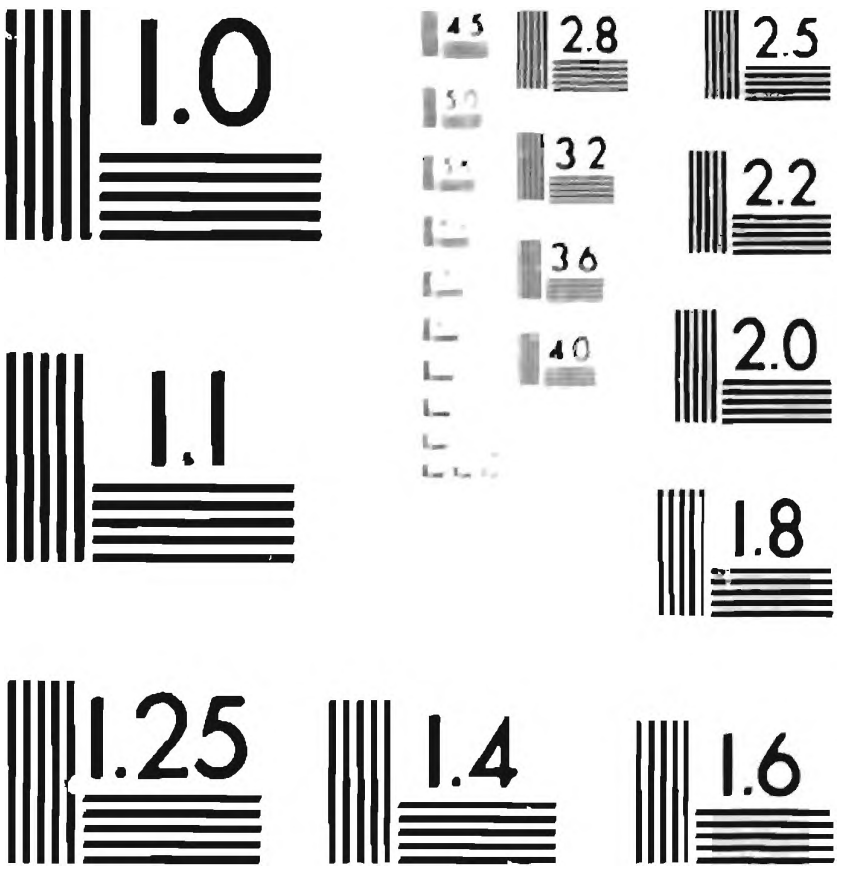
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



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UNITED NATIONS
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A STUDY TOUR OF THE PHARMACEUTICAL INDUSTRY

IN THE

WEST BANK AND GAZA STRIP

UC/PLO/83/006

Report */

prepared by the
UNIDO Secretariat

Based on the work of Simon H. Kuttab, expert in pharmaceuticals
and Ramzi Sansur, expert in biologicals

2596

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TABLE OF CONTENTS

Table of Contents (Cont.)

LIST OF TABLES

INTRODUCTION

Several attempts to begin drug production in the West Bank were made prior to 1967. However, each attempt faced difficulties either in obtaining a licence or in financing for any serious production start-up plans. At least one firm, Jordan Chemical Laboratory, was issued a licence but limited its production to creams, ointments and simple preparations.

The 1967 Israeli occupation of the West Bank came as a severe blow for the few drug stores and agents that imported all of their pharmaceuticals from abroad. Due to obstacles imposed by the occupation, stocks of drugs were depleted without any prospect of renewal by the Palestinian import agents or drug stores. The general feeling was that the West Bank would, sooner or later, become dependent on Israeli pharmaceutical firms and importers of foreign drugs.

As a result of this situation and of the vacuum created in drug supplies, a number of pharmacists and concerned citizens attempted to establish pharmaceutical production on the West Bank. Until recently, pharmaceutical production in Gaza had not been attempted.

The initiators of pharmaceutical production on the West Bank were initially hesitant to commit their monies to such a project, due both to the uncertain future of the West Bank

and to the difficult economic situation following the the 1967 Israeli occupation. However , by 1969 nine small pharmaceutical firms with limited production and facilities were in existence. The Israeli authorities were unhappy with this situation and cancelled the licences of the existing firms, subsequently issuing only two licences. This forced the existing companies to merge into two : Palestine Medical Company and the Jordan Chemical Laboratory. After further manipulations a third licence was issued to the Jerusalem Pharmaceutical Company.

Between 1970 and 1975 more licences were issued allowing the establishment of several new pharmaceutical firms on the West Bank. The reason for such a move was not clear, but changing Israeli attitudes towards the West Bank plus internal problems within the newly merged firms were contributing factors.

Currently there are seven pharmaceutical firms in the West Bank , six in the greater Ramallah/Al Bireh area and one in Beit Jala. In addition, there is a small pharmaceutical firm in Nablus which produces veterinary preparations. This firm was not included in our survey. Two pharmaceutical firms are presently being established in the Gaza Strip. It must be stressed that some of these companies produce cosmetics as part their production line and one that also produces insecticides packaged in aerosol cans.

PHARMACEUTICAL COMPANIES IN THE WEST BANK

The seven pharmaceutical companies in the West Bank with their year of establishment and capital are listed in Table 1. A total of 691 products is currently manufactured, as shown in the Table. These numbers were obtained from both interviews and the presciber's guides. However, the prescriber's guides for six of the companies were not current. In addition to pharmaceuticals, the figures include a small number of cosmetic preparations and aerosols manufactured by some of the companies. It is note-worthy that these numbers fluctuate, depending on : market needs, availability and cost of raw materials, economic benefit to the manufacturing company, and competition from other manufacturers. Several products also include the same active ingredient in different dosage forms and concentration.

Table 1. Description of the West Bank Pharmaceutical Companies.

Company	Year established	Capital Per J.D	Number of Products *
Jordan Chemical Lab.	1969	150.000	121
Palestine Medical Co.	1969	150.000	140
Jerusalem Pharmaceuticals Ltd.	1969	300.000	81
Balsam Medical Co.	1970	300.000	94
Birzeit Pharmaceutical Co.	1974	350.00	110
Eastern Chemical Co.	1975	118.500	86
Gama Chemical Co.	1978	100.000	73

* Refer to text for details.

The number of pharmacists, chemists, and the overall number of employees is shown inTable 2. It can be concluded that the number of pharmacists and chemists employed represents about 12% of the total working force. We believe that this percentage remains constant. However, the total number of employees in each company is unstable and can vary from one month to the next.

Table 2. Number and Training of Employees.

Company	Pharmacists	Chemists	Total Number of Employees
Jordan	2	2	30
Palestine	3	3	45
Jerusalem	2	2	48
Balsam	2	3	35
Birzeit	2	4	44
Eastern	2	1	17
Gama	1	1	18

Space, Equipment and Raw Materials

The space which each company occupies and the area allocated to the various divisions is described in Table 3. The Jerusalem Pharmaceutical, Balsam Medical, Birzeit Pharmaceutical and the Jordan Chemical occupy their own buildings. The others operate in rented facilities. Eastern Chemical and Palestine Medical have had more than one building in close proximity to each other. Gama Chemical is currently constructing a facility of about 1,000 square meters. The companies do not base the number of products they manufactue on the size of the production area or, for that matter,for the total area of the company.

Table 3. Available Space in Square Meters.

Company	Production (%)	Control Lab (%)	Storage (%)	Offices (%)	Total*
Jordan	670 (42)	20 (1)	500(31)	400(25)	1600
Palestine	400 (40)	15 (2)	500(50)	100(10)	1000
Jerusalem	650 (30)	50 (2)	650(30)	250(11)	2200
Balsam	1150 (49)	50 (2)	500(21)	470(20)	2350
Birzeit	400 (25)	60 (4)	800(50)	150(9)	1600
Eastern	200 (36)	8 (2)	200(36)	100(18)	550
Gama	100 (29)	20 (6)	100(29)	35(10)	350

* Total includes hallways, corridors & others.

Areas devoted to production and storage clearly occupy most of the space. There is no correlation between the space devoted to production and the number of products manufactured. However, there is some positive correlation between the number of products manufactured and the percent area devoted to storage. Areas allocated to storage are not sufficient for company needs, as the companies complained to us about the shortage of storage and warehouse facilities.

The space assigned for the quality control laboratory is considered inadequate for analyzing the large number of drugs produced by any one company. Unfortunately, the quality control laboratory does not play as important a role as it should, due to many factors discussed later. Six of the seven West Bank companies provided us with the list of their equipment(Appendix A). Balsam Medical refused to provide us with a list of its equipment

and instrumentation. From our onsite visit Balsam's equipment and instrumentation for production and quality control appear to be similar to any of the other companies. The laboratory equipment at all companies meets the minimum requirements subscribed by the Jordanian law.

All equipment, spare parts and raw material are imported, in most cases, directly by the companies from foreign sources. Some packaging materials such as cardboard boxes, plastic containers and glassware is bought primarily from local West Bank sources. During our interview, we did not find any problem in acquiring any of the necessary materials. Also adequate spare parts are kept in stock. The companies depend on their own experienced employees to service and maintain their production equipment. Occasionally companies cooperate regarding machine maintenance. They do not rely on Israeli service personnel.

The companies have geared their production to take frequent power interruption into consideration. Some of them have their own generators and voltage stabilizers. Water supply seems to be adequate to meet their needs.

Productive Capacity and Related Problems

The output of the West Bank companies amounts to approximately

30% of their productive capacity. This low number is due to the limitation of having a small and highly competitive market, coupled with an inability to export either via Jordan or through Israeli ports.

Attempts to export West Bank pharmaceutical products through Jordan met many difficulties and is currently at a stand still. The Arab Boycott Organization requires the import of all raw materials needed for production via Jordan. This requirement presents many difficulties to the companies although they are willing to go through this procedure. At one point in the negotiations, the Jordanian Government approved the export of some products after proper registration. A number of companies registered some of their products; however, Jordan retracted its approval and stopped any drug registration procedures. Presently export to and through Jordan seems to be impossible. Export to other countries via Israeli ports is also difficult. The West Bank companies are limited in both their productive facilities and available capital. In addition, it is not possible to obtain a statement of origin with Jordan as the source. Since the products are not registered and marketed in Jordan, this cannot be done.

FINISHED PHARMACEUTICALS.

Description of Products

The number of pharmaceutical products currently manufactured bythe

seven West Bank firms exceeds six hundred. These products are marketed in different dosage forms and in different concentrations when appropriate. Table 4 shows the various dosage forms and the number of products in each form manufactured by the companies. It does not include any cosmetics, aerosols or detergents. The figures were obtained from our interviews and the prescriber's guide of each of the companies.

It has been difficult to obtain precise numbers since modifications in the kind and number of products can be introduced at any time. A decision for deletion or addition of certain products is made by the Board Of Directors on recommendation of doctors or sales agents, or is based on production cost, availability of raw materials, and competition from other products. However, the figures shown can be considered fairly accurate. All the companies manufacture a large number of products in the form of tablets, capsules and syrups or suspensions. Ampules are manufactured only by three companies, namely, Birzeit, Palestine and Jerusalem. Eastern can be considered to be the leader in the preparation of eye drops since it has recently acquired a small West Bank firm in existence since about 1970. It is obvious from the table that none of the companies specializes in a certain dosage form.

Table 4. Dosage Forms Manufactured by West Bank Companies.

Type	Company						
	Jordan	Palestine	Jerusalem	Birzeit	Balsam	Eastern	Gama
Tablets	39	34	24	31	29	11	6
Capsules	7	16	11	12	18	14	7
Suppositories	16	7	6	7	-	-	-
Ampules	-	18	6	22	-	-	-
Ointments & Creams	12	10	8	6	7	9	7
Syrups & Susps.	25	30	19	21	30	19	17
Eye, Ear & Nose drops.	8	14	-	2	3	19	-
Lotions	1	2	1	-	1	-	1
Granules	2	1	-	-	2	-	-
Powder	2	6	2	-	-	1	2
Mouth Wash.	-	1	1	-	1	1	1
Lozenges	-	2	-	-	1	-	-
Paint	2	-	-	-	1	2	1

Table 5 is an attempt to list the various types of products in each pharmacological class. The figures are derived from the prescriber`s guide of each company. Six of these prescriber`s guides are at least three years old and only Birzeit was able to provide us with 1983 guide. The other companies expect a new edition within a few months. The products mentioned in these guides are constantly being modified as mentioned earlier. All the products are included in the 30 different categories shown in Table 5. In some cases, a product can fit into more than one category. However, such products were entered only once and placed in the most suitable category. In addition, a product manufactured in more than one concentration has been entered only once.

An examination of Table 5 shows the overlap between the companies and any possible specialization that exists among them. These companies clearly have many products in common, especially in the classes of antibacterials, antiinflammatory-antirheumatic agents, antitussives, analgesics - antipyretics, vitamins -hematinics, and dermatological preparations. From our interviews, it has been concluded that the three best selling classes for any of the companies were the antibacterials, antiinflammatory - antirheumatic agents, and the analgesics - antipyretics.

Table 5. Number of Products in Each Pharmacological Class

Product	Company						
	Jordan	Palestine	Jerusalem	Birzeit	Balsam	Eastern	Gama
Analgesics Antipyretics	10	4	2	5	5	1	3
Chemotherapeutic Agents.	8	20	7	9	13	5	4
Antiinflammatory Antirheumatic.	10	8	4	3	7	1	-
Intestinal Antiseptics/Antidiarrheas	5	4	1	1	4	1	1
Antacids	3	2	1	-	2	1	1
Antihistaminics	4	2	1	2	1	1	-
Anthelmintics Antiamebics	1	2	2	1	3	1	1
Antispasmodics Anticholinergics	4	3	4	2	2	2	-
Antitussives Expectorants	5	5	1	2	4	3	1
Vitamins/hematinics	7	10	7	5	2	5	3
Muscle Relaxants	-	-	-	-	2	1	-
Tranquilizers/Sedative hypnotic	3	2	1	1	1	-	-
Antiasthmatics	7	2	1	1	1	1	-
Hypoglycemics	1	-	1	-	-	-	-
Urinary Antiseptics	2	1	-	-	1	-	-
CNS Stimulants	1	-	-	-	-	-	-
Laxatives	3	-	-	-	-	2	-
Diuretics	1	1	-	-	-	-	-

Table 5. Number of Products in Each Pharmacological Class (Cont.)

Product	Company						
	Jordan	Palestine	Jeruslem	Birzeit	Balsam	Eastern	Cama
Antiemetics	3	1	1	2	1	-	-
Peptic Ulcer Agents	-	1	1	1	-	-	-
Gargles/mouth paints	2	3	1	-	2	3	1
Ointments/Creams Powders	11	11	8	5	5	7	8
Eye,Ear, Nose drops	8	14	-	2	3	19	-
Aphrodisiacs	1	-	-	-	2	-	-
Antihemorrhoids	3	-	-	-	-	-	-
Hormones - Anabolic	-	-	-	6	-	-	-
Antihypertensives	-	2	-	2	-	-	-
Fertility Agents	-	1	-	1	-	-	-
Cardiotonic Agents	-	1	-	-	-	-	-
Oxytocic, Uterine bleeding	-	1	-	-	-	-	-

Table 5 also indicates that the manufacture of certain critical and highly potent drugs is not a top priority. This includes cardiovascular preparations such as antihypertensives, antia ginal agents, antiarrythmics, antiatherosclerotics, digitalis, cerebral and peripheral vasodilators, antifibrinolytic agents and diuretics together with the hypoglycemic agents, hormones, contraceptives, and enzyme preparations. In fact, there are only two diuretics produced by two different companies, namely Jordan and Palestine, one cardiotonic by Birzeit, six hormonal preparations by Birzeit, two hypoglycemics by Jordan and Jerusalem. In addition, preparations for antiparkinsonism, muscle relaxants and antidepressants are not numerous. A large variety of dermatological preparations which contain antibacterials, antifungal agents, antihistaminics, and steroids in various combinations are produced and amount to about 57 preparations. There are about 46 different eye, ear and nose drop preparations.

From our discussions with the firms' executives, it was obvious that they are reluctant to introduce critical and potent products such as the cardiovascular preparations, partly because the companies do not want to commit themselves to such products, but most importantly, due to the hesitation observed among the doctors who are unwilling to experiment with a new but critical product on their patients.

Thus medical doctors depend mainly on foreign products first, followed by Israeli products second.

Efficacy and Quality

The information included in this section has been obtained mostly through interviews conducted with physicians, and other concerned individuals. The list of people interviewed is included in the acknowledgements section. In all cases, a list of questions was asked, followed by a general discussion in order to obtain an impartial and reasonable evaluation of the efficacy and quality of the various products. With the physicians, we have concentrated mostly on the product's efficacy and with pharmacists our concern was with the product's quality.

Efficacy is a difficult property to determine and needs long clinical investigations coupled with laboratory data. Information included in this section is based on interviews. Before reaching any conclusion with regard to efficacy, it is important to determine whether proper diagnoses have been made. Unfortunately, we cannot always guarantee proper diagnosis with all the doctors. In addition, a number of drugs, including antibiotics, are overly and unnecessarily prescribed without proper diagnosis. Many patients go to more

than one physician and do not come back to the same physician for a check-up. These and other factors make the determination of efficacy by the prescribing physician a difficult task. We believe that we were able to obtain reasonably accurate information from some of the physicians, who were following a scientific approach in the evaluation of the West Bank Pharmaceutical products.

We found that a general practice among a large number of doctors is to prescribe a foreign antibiotic in preference to an Israeli product for a seriously sick person. The West Bank Product is only prescribed in mild cases. Physicians in general have no confidence in the locally manufactured antibiotics and have complained about their efficacy. Many physicians insist that their lack of confidence is based on experience and experimentation. We also found little confidence in the bronchodilators, diuretics, hypoglycemics, and the antiinflammatory - antirheumatics. This does not mean that all such products were found to be inefficacious at all times. In fact, some doctors feel that there maybe variations from one batch to another. This discourages them from prescribing any such product for serious cases.

Other less critical products such as analgesics - antipyretics, antidiarrheal, and antacids are prescribed and doctors

had fewer complaints about their efficacy. There have been complaints about the efficacy of the dermatological preparations, suppositories and vaginal fungicidal inserts. The efficacy of the vitamin preparations is still questionable and thus physicians favor the foreign or Israeli products. The acidity of some of the ampules has also been found objectionable resulting in decreased efficacy and discomfort to the patient. Some of these problems were presented by concerned physicians to the companies and in some cases certain modification were introduced.

The conclusion we were able to draw is that the overall efficacy of some West Bank products is low. It is to be understood that a number of products are believed to be quite efficacious and are prescribed routinely. On the other hand, some of the physicians are unwilling to experiment with the patients and thus rely heavily on the foreign and Israeli products. We noticed that an additional contributing factors to the hesitation in use of the local product is the belief that such products are not regularly controlled, studied, evaluated and modified, as is the case with the foreign products.

With respect to quality, most individuals interviewed believe that significant improvements in the quality of the products have been introduced in the last two years. There

are still complaints with regards to tablets coating, hardness, friability , discoloration, caking of some suspensions, microbial growth, and leaking bottles. In addition, there are complaints about the slow disintegration of suppositories. The high glycerin content in some suppositories has been reported to result in diarrhea. The sterility of eye drops is questionable and precipitate formation occurs in some batches. Another problem is the reported nonuniformity in the color of capsules of certain products resulting in confusion of the patient and the pharmacist. In general, all problems have been significantly decreased over the last two years.

Since September 1982, the Israeli authorities have required an analysis of each batch of antibiotics. The authorities also run random spot checks and analyses of other local products on the market. This is carried out by one person who collects samples at random from the market and submits them to an Israeli analytical laboratory : The Institute for the Standardization and Control of Pharmaceuticals. This sampling is by no means exhaustive and does not cover every batch of a product on the market. The result of such analyses become available at least two to three weeks after sampling and in most cases longer. In the interim the drug would have reached the market. Recall procedures by the companies can take another month. This resultsin the consumption of

a fair amount of a drug before any recall notices take effect. The same applies to the antibiotics, since they can be marketed before receiving the results. Table 6 is a cumulative list of all products since September 1982 which did not meet the standards as determined by the Israeli analytical laboratory and which were required to be withdrawn. While none of the problems was critical or dangerous in nature, such data reflect on the quality and efficacy of these products.

Recently the Israeli authorities have also required inclusion of the manufacturing date and expiration date (if any) on each product, both on the container and outer packing. No product is to be sold five years after manufacturing, or three years, in the case of an antibiotic.

Shelf life and stability studies performed by the companies are in most cases, believed to be inadequate. By checking samples of products at doctors' offices, it has become evident that deterioration of some products occured with time. Such problems include discoloration, coating cracking, disintegration of some tablets, caking and microbial growth. It is not clear if the companies are aware of such problems or have had them documented. Stricter and more careful quality control of in-process material, final products, and shelf-

Table 6. List of Recalled Drugs.

JORDAN CHEMICAL LABORATORY

Product	Batch No.
1. Diasix Tab.	120
2. Paravomine Tab.	621
3. Diapect	388
4. Codinal Tab.	773
5. Codinal Tab.	777
6. Codinal Tab.	776
7. Rufen Tab.	106
8. Novodexon Elixir.	All Batches.
9. Neospasmyl Suppos.	1221
10. Ampitricine Caps.	126
11. Vomazine Drops.	227

PALESTINE MEDICAL CO.

1. Neopectal Susp.	8742
2. Urosept Caps.	8723
3. Oxycin Caps.	8781
4. Dopamine Tab.	8836
5. Deqasept Paint.	8270
6 Dologesic Caps.	8624
7. Nystagyl Vag. Tab.	8534

JERUSALEM PHARMACEUTICAL CO.

1. Urocycline P. Caps.	0128210
2. Olvit drops	All Batches.
3. Dexamin Tab.	0198210
4. Magnagel Susp.	7825

BIRZEIT CO.

1. Abcedin Tab.	4474
2. Becovit Amp.	4566
3. Neokal Tab.	4144
4. Decomb Cream.	4678

Table 6. List of Recalled Drugs.
(Cont.)

BALSAM MEDICAL & CHEMICAL CO.

Product	Batch No.
1. Balsprim Susp.	1920
2. Flu Syr.	1975
3. Ultragel Susp.	1986
4. Ibufen Tab.	1849
5. Terabal Caps.	1755
6. Protogyl Tab.	1191

EASTERN CHEMICAL CO.

1. Ampen Caps.	2138
2. Otocidine Ear drops	2152
3. Medocin Caps.	2053
4. Cefadin Caps.	2118
5. Ponsan Caps.	1049
6. Decongex Nose drops.	2157
7. Prodin Caps.	1069
8. Locasept N. Oint.	1003
9. Chloroceline Eye drops.	3056
10. Otocidine ear drops.	3176

GAMA CHEMICAL CO.

1. Solvocillin fort Caps.	1489
2. Policillin Susp.	1516
3. Amoxyl Caps. 500mg.	1532
4. Gamacycline Eye Oint.	1509
5. Clenzo mouth paint.	1023
6. Amoxyl Caps.	1496
7. Gamacycline skin Oint.	1638
8. Neutrolox Susp.	1652
9. Baby cure lotion.	1670
10. Zinc Oxide Oint.	1110
11. Icthyol Oint.	1639
12. Gamavit with Iron Syr.	1591
13. Aspiril C. Tab.	1366
14. Solvocillin fort Caps.	1653
15. Gamacycline Eye Oint.	1598
16. Amoxyl Caps. 250 mg.	1649
17. Amoxyl drops N.	1246
18. Neutralox Susp.	1713
19. Aspiril C. Tab.	1733
20. Amoxyl Caps. 500mg.	908
21. Clenzo Mouth paint(10cc)	875

life is needed to allow for modifications and to guarantee a better quality.

Physicians and pharmacists are disturbed by the wide variety of competing local products. Both groups expressed interest in better coordination and specialization among companies so as to decrease the number of competing products and conserve efforts and resources towards the production of a smaller number of highly efficacious products.

ESSENTIAL DRUGS NEEDED

The West Bank is a good market for Arab products, as well as competing Israeli and foreign products. Israeli pharmaceutical companies can produce drugs more cheaply than the West Bank firms. Moreover, the Israeli firms have a larger and more open market, are more aggressive in marketing and have the support of their government. Foreign products, on the other hand, enjoy a good international reputation. An adequate supply of all kinds and classes of drugs is provided through these three sources.

The Arab products, in most cases, are 10 to 20% cheaper than the Israeli products and 30 to 40% cheaper than the foreign products. However, some Arab products are more expensive

than the Israeli equivalents. The West Bank products account for 30-40% of the local market (depending on the area), Israeli products for about 40%, and foreign products for the rest. From our interviews, it seems the West Bank companies are reluctant to get into the production of critical and dangerous drugs, and also of less economically rewarding products. It is obvious from Table 5, that the classes of drugs missing from production include the cardiovascular preparations such as the antianginal, antiarrhythmics, antiatherosclertics, digitalis, and cerbral and peripheral vasodilators.

In addition, local firms manufacture only two antidiabetics, one diuretic, two antihypertensives, and one antidepressant. Another area which needs improvement is that of hormones, enzyme preparations, and the central nervous system agents. However, all of the above missing products are adequately supplied by Israeli and foreign companies at prices which the West Bank firms might not be able to meet. It is our opinion, that with proper specialization and consolidation of activities, the West Bank companies would be capable of producing some of the above-mentioned products at competitive prices. In addition, the companies would have to implement stricter product quality control measures. This would increase physician's and consumer's confidence in such needed products.

CONSOLIDATION OF ACTIVITIES

In 1969, nine small pharmaceutical firms in the West Bank produced a small number of pharmaceuticals to fulfil some local needs. In 1970, these companies were consolidated into three main companies, in order to meet the authorities licencing requirements and regulations. In the same year, however, more licences were issued and the number of companies increased to the seven currently existing.

In 1976 and 1977, The Physicians`Union attempted to assist the companies in their development, and with the consolidation of their activities in order to cut down on competition, improve product quality and decrease consumer cost. However this effort did not succeed despite more than ten meetings between the companies and the physicians.

The Pharmacists`Union has also made several attempts and is currently trying to consolidate the activities of the companies, including monitoring product quality and controlling prices. Very recently the Pharmacists`Union proposed the establishment of a technical committee whose members would include the head of the Physicians`Union, head of the Pharmacists`Union and head of the Dentists`Union, in addition to various Pharmacisits and Academicians.Such a commit-

tee has not yet been officially established and may not be accredited by the companies. However, we are not optimistic that such an effort will succeed. These efforts have been aimed at assisting the companies in their development, improving product quality, decreasing costs and reducing the heavy burden laid on pharmacists to carry a large number of similar products. Also pressure on physicians to prescribe products for the various companies is reduced.

From our interviews, it has been concluded that the top selling products are common to all of the companies and include antibiotics, analgesics - antipyretics, and anti-inflammatory - antirheumatics. Thus each company is reluctant to give up products that may reduce its profit margin. The competition among these companies takes various forms and includes offering bonuses to pharmacies, free samples, gifts to some doctors who may or may not be shareholders in the company, and discounts on various products. In addition, there is competition from Israeli and from foreign products. The Israeli companies specialize more among themselves, have a larger and open market and obtain support from their Government. Thus they provide tough competition.

As a result, there have been several meetings and discussions among the West Bank companies to consolidate

their activities. Proposals have included a reduction in the number of companies, specialization in certain pharmacological classes of drugs, specialization within the same class of drugs, and specialization in certain dosage forms. These proposals have not been fully approved or implemented. All such efforts have reached a dead end basically due to the self-interest of each company and its shareholders. Presently the only existing coordinating body among the companies is the Committee of The Arab Pharmaceutical firms in the West Bank city of Ramallah. This committee is limited in its functions and its efforts are mostly directed towards : 1) Challenging any unfavourable decisions taken by the occupying authorities, and 2) the coordination of local tenders.

Based on our interviews and the pharmacological classification of the various products (Table 5), it is obvious that some of the companies have attempted to manufacture unique products to avoid any competition. For instance, two diuretics are produced by only two companies, namely Jordan and Palestine, four antihypertensives by Birzeit and Palestine, two hypoglycemics by Jordan and Jerusalem, one antidepressant by Jordan, three muscle relaxants by Balsam and Eastern, and six sex hormones by Birzeit. Some micro-encapsulated raw material is imported and packaged by Balsam.

It has been, also, obvious to us that the competition among these companies is great. Most company executives are not optimistic about any unification, consolidation of activities or specialization. It seems that they are not presently facing any serious challenges that would force them to unify. However, we do see a great need for closer cooperation. The companies now have the basic equipment to manufacture various products with very minimal, if any, quality control. Any consolidation of activities would allow them to upgrade product quality, have better product control and should prove economically rewarding.

Thus we would like to recommend the following options or possibilities ranked in order of preference :

i) Reduction of the number of companies to two. This could be accomplished by unifying them on a sound scientific basis and merit, taking into consideration expertise, facilities and any currently existing specialization, but without consideration of any individual preferences or interests.

ii) Specialization among the existing companies based on drug classes. This could be done by subdividing the three best-selling classes of drugs, namely the antibiotics, analgesics - antipyretics, and antiinflammatory-antirheumatics. Each of the three classes would be manufactured

by two companies only. In addition, the companies could subdivide the remaining twenty seven classes of drugs mentioned in Table 5 among themselves.

iii) Specialization based on the various dosage forms. For instance, ampules are currently manufactured by Birzeit, Jerusalem and Palestine, while Eastern, Palestine and Jordan produce several types of eye drops. This kind of specialization could be evaluated, reorganized, and extended to cover all dosage forms and companies.

Any of the above possibilities could be a starting point for the reorganization of drug production in the West Bank. Such a reorganization is essential in order to decrease the competition among the Arab companies and thereby improving their position to compete with Israeli and foreign products. Such a move would revitalize the companies, as they have been adversely affected by the latest currency devaluation and economic slump on the West Bank. In fact, the latest devaluation has reduced the price gap between West Bank and Israeli products. In addition, such a move would allow each company to concentrate on a limited class of drugs which should result in better controlled and more marketable products. Pharmacists would be less pressured to carry a wide number of products and physicians would be under less pressure to prescribe products from different companies. This can better guarantee the health

and safety of the consumer.

GUIDELINES FOR IMPROVEMENT

The following guidelines have been prepared, based on interviews and on-site inspection of the facilities of each of the seven West Bank companies.

A. Buildings and Facilities.

The seven West Bank firms vary extensively in the size and organization of their facilities and also in the extent to which such facilities are maintained. Jerusalem, Birzeit, Balsam and Jordan occupy modern, reasonably spacious facilities constructed to serve the purpose of drug manufacturing. Eastern, Palestine and Gama operate from modified rented facilities which are not spacious enough to suit their needs. Adequate space in any drug manufacturing company is important in allowing for the orderly placement of equipment and material to prevent mixups. In addition, it facilitates adequate cleaning, maintainence and proper operation in the manufacturing, processing, packing, labeling or holding of drugs.

An important aspect of any facility is, also, the division within the plant of the various production processes (both

machines and products). This is important in order to reduce cross contamination and to prevent mixups. The manufacture and processing of the penicillins must be performed in separate areas having their own independent ventilation system in order to prevent cross contamination with other products.

Ventilation has been poor in some of the companies and noneexistant in others. Proper ventilation, including filters and prefilters with humidity control regulates the environment in the buildings and thus prevents contamination from external sources. Each filling machine must have a dustcollecter capable of removing not only powders but broken tablets and pieces. The dust collection system can be installed on the roof or near each machine. Areas producing aseptic compounds and areas for the dispensing of all raw material should have a laminar flow system.

The seven companies have substandard storage facilities. The storage areas are not clearly divided and defined to prevent contamination or mixups. On more than one occasion we have observed damp, moldy storage areas with raw materials lying around in a disorderly and unsanitary way.

The sanitation aspect of any company should include : Personal hygienic practices, prevention of infestation by

vermin, flies and other insects, cleaning schedule of equipment and utensils, and sanitary maintenance of toilets and washing facilities. Also included is the cleanliness of plant surroundings, and waste disposal. These aspects are loosely follow by the pharmaceutical companies. Thus we would like to recommend the following:-

1) Expansion of the current facilities is needed for Palestine, Eastern and Gama. Birzeit, Jordan and Jerusalem should introduce new sections for some of the production process and for storage. However, it should be stressed that before investing in such costly expansion, priority should be given to consolidation of activities and possible unification.

2) There should be clear divisions of the various production stages. Our recommendations are :

i) To have separate weighing rooms with their own air handling system.

ii) A typical granulating room should be subdivided into a milling and sizing booth, a blending booth, a mixing and a granulating booth and a drying area with drainage in each booth to facilitate cleaning.

iii) Tablet and capsule production should have separate rooms for tablet compressing and capsule filling, each equipped with humidity control devices. Each machine should have its own separate booth. Such rooms should have ample space to accommodate inprocess testing equipment such as a

tablet hardness tester and balances.

iv) A separate room should be assigned for tablet coating with proper noise insulation and dust control. Drainage should be provided for easy cleaning of the coating pans and floors.

v) Liquid manufacturing should be carried out in a special area with proper cleaning and sanitation facilities, particularly to avoid microbial contamination in some products. Routine microbiological and chemical testing must be performed on water and sterile liquids. It is necessary to have separate facilities for oral and external or cosmetic preparations.

vi) Ointments and creams should be handled in a way similar to other dosage forms. Cosmetic preparation should be separate from medical preparation.

vii) The packaging and labeling department should be separated to prevent cross-contamination. Packaging lines should be separated so as to avoid product mixup. This area must be kept sanitary.

3) The introduction of ventilation, air filtration dust collecting and exhaust systems is necessary, especially in production areas in order to avoid any cross-contamination. Areas handling penicillins should have separate air handling system.

4) We recommend a sizable increase in the storage areas of all companies with clear subdivisions of the storage area. These subdivisions should include a quarantine area for incoming raw materials and packaging materials, rejected finished products, released components and in-process materials. In addition, more care should be taken in cleaning and maintaining these areas in order to avoid unsanitary conditions.

5) There should be written procedures for sanitation including assignment of responsibilities, scheduling, descriptions of methods, equipment and materials to be used in cleaning of the facilities and equipment, and procedures for the use of pesticides.

B. Equipment

Most of the production equipment used is foreign and is expected to meet international standards and specifications. We did not find any written procedures for equipment use, cleaning or maintenance in any company. Such written procedures need to be established and followed before the equipment is utilized for another batch. This should also include a record signed by the individual doing the work which indicates the type of drug being produced, the date and the time of starting and ending work. Persons doing the cleaning and maintenance of the equipment should also

sign a special record kept for that purpose. Such procedures are intended to prevent mix-ups and cross-contamination and would give the employees a greater sense of responsibility.

As indicated from the list in Appendix A, most of the companies have adequate production equipment. Such equipment, is underutilized especially the more automated machinery. Upon evaluation of the currently available equipment including discussions with the managment of each company, a list of equipment and instrumentation needed by each of the companies is shown in Appendix B. This list represents the aspirations of the companies to automate, improve and facilitate their production.

It is our opinion that the companies should unite or consolidate their activities to make the maximum shared use of the existing equipment. However, if the companies remain divided as they are now, some of the smaller companies are in immediate need of some production equipment. Such a need can be seen by comparing the lists in Appendixes A and B.

C. Quality Control Unit

The West Bank pharmaceutical companies lack a quality control

unit whose responsibility includes approving or rejecting drug products, packaging and labeling material. The units' authority should extend to reviewing all production records in order to check for any errors and to insure compliance with internationally acceptable standards. Throughout our onsite visits, we could not identify any unit having the overall authority to supervise product manufacturing in all its aspects. It is imperative that such a unit be established and have at its disposal adequate laboratory facilities for testing all components used in the manufacture of each product.

D. Laboratory

The companies meet the minimum standards for a quality control laboratory as specified by Jordanian law. In our opinion, the equipment available in those laboratories is inadequate and cannot possibly be used to analyse the wide variety of active ingredients incorporated in any one product. Thus, more sophisticated and advanced instruments must be introduced. There is a definite need for most of the companies to use their laboratories more efficiently and to establish their own methods of analysis. While most companies follow the procedures in the official compendia, such procedures are written mostly for the assay of one active ingredient. Any new methods developed should have

written procedures which include the accuracy, sensitivity and reproducibility of the method. We also found a need for written sampling procedures at the various stages of processing. Such information should be part of the master production file described later. There is also a need for stability testing of the final product. While most companies retain samples for a certain length of time, there are no written procedures and no evidence that the samples are tested according to a specifically maintained and executed schedule.

With respect to the laboratory, it is our recommendation that significant improvements in the instrumentaion need to be introduced. There should be more dependence and utilization of the laboratory to guarantee product quality. The following is a list of laboratory instruments which each company should acquire :

UV/Visible scanning spectrophotometer.

High pressure liquid chromatograph with variable wavelength UV detector.

Thin layer chromatography system.

Infra red spectrophtometer with quantitative capability.

Electronic analytical balances.

Moisture determination apparatus

Tablet disintegration apparatus

Tablet friability tester

Dissolution rate tester.

Laminar flow hood.

Microscopes.

Zone reader

E. Qualifications

The personnel engaged in all aspects of manufacturing and quality control lack proper qualifications and training. Table 2 indicates the approximate number of employees and number of chemists and pharmacists in each company. It can be concluded that chemists and pharmacists represent about 12% of the total working force. We believe that such a number is low and should be increased to insure better quality and efficacy of the products.

F. Control Of Components

There is a need for procedures describing receipt, identification, storage, handling, sampling, testing and approval or rejection of components, drug products, containers and closures. Special testing procedures for sterile products such as eye drops and ampules should also be documented

and implemented. In addition, tests on the properties of tablets and capsules need to be established and strictly followed. Such tests include tablet hardness, and friability, disintegration and dissolution rates where appropriate for tablets, capsules, and suppositories.

Records and record keeping should be vastly improved. Duplicates of all such records should be stored both at the laboratory and in the batch production and control file for future reference.

We understand that raw material is tested prior to use in most companies but that in certain cases the company depends on the certificate of analysis provided by the manufacturer of such component. In our opinion, raw materials have to be identified and analyzed in the company to check for any possible deterioration as a result of exposure to excessive heat and humidity during transport. In addition, containers and closures should be checked to determine if they conform to the company specifications. There should also be quarantining facilities for untested or rejected components.

5. Records and Documentation

During our site visits, it was obvious that the companies lack an organized and adequate record keeping and documetation system. All the companies keep some records of the

products, batches, laboratory control results, and distribution records. However, it is our opinion that such a system is neither well organized nor adequate. The following sections represent a list and description of some of the various files, records and documents which each of the companies needs to introduce, organize and make readily available for inspection.

i) Production and Control Procedures :

This file should include written procedures and all reasonable precautions taken to assure that the product has the desired strength, quality, purity and identity. Procedures dealing with weighing and measuring of components, addition of ingredients used during processing, identification and labeling of containers, use of control numbers, calculation of yield, equipment identification, and sampling and tests to be applied in process are to be included. In additon, precautions to avoid microbiological contamination or cross-contamination and time limitations for the completion of each phase in production are to be included. An additional section to this file should include packaging and labeling controls to insure no mix-ups in the final product. The introduction of such a document and the implementation of its procedures should provide for better control and guarantee the quality and efficacy of the product.

ii) Master Production and Control Records:

A master production file for each drug product and each batch size should be prepared in order to guarantee uniformity from one batch to another. The information in this file should include name and strength of the product, weight of each active ingredient per dosage unit and the total weight, list of components, a statement of the theoretical weight at appropriate phases of production, and the acceptable theoretical yield. In addition, the file should include a description and sample of all packaging and labeling material, and a complete description of sampling and laboratory procedures from the various phases of production, as well as any precautions to be taken.

ii) Batch Production and Control Records:

While some of the companies provided us with a production sheet, such a sheet is not adequate. This record should be an accurate reproduction of the master production file corrected for any deviations in amounts or weights for a particular batch. Any such file, including changes in it, has to be checked, dated and signed independently by two competent individuals. In addition, this record should include documentation that each of the significant steps has been properly executed. This information should be signed

by one person and verified by a second, and include weighing, mixing, sampling, quality control laboratory results, yields, control of the packging and labeling process. In addition, it should account for any deviations and investigations made during processing and should include the identification of the persons performing and checking each significant step.

iv) Complaint File:

Written procedures describing the handling of written or oral complaints should be established and documented. The role and function of the various units in such a complaint is to be specified. It should include the details of any investigation conducted and the measures takes as a result.

TRAINING CENTER

Based on our visits, we believe that the companies cannot provide adequate facilities for a training program on their premises. Birzeit University has established a Center for Environmental and Occupational Health Sciences whose activities include quality control analysis of marketed pharmaceuticals and assays of environmental samples.

Birzeit University is an independent institution which is

in close proximity to the seven West Bank pharmaceutical companies and the Center has adequate and modern facilities both for demonstrations and for training personnel in laboratory quality control methods. Therefore, we believe that the Center for Environmental and Occupational Health Sciences at Birzeit University is capable of offering a training program. Such a program could include aspects of industrial pharmacy, laboratory quality control and review of good manufacturing practices.

The program is directed towards individuals with college training. It can be divided into two major parts :

A. Practices of Industrial Pharmacy.

B. Laboratory Quality Control Methods.

Any interested person can take either or both parts, in addition to a review of good manufacturing practices. An outline of the programme is presented below and is designed for five-day course which includes reading materials, presentations, demonstrations, and on hand laboratory experience:

A. Practice of Industrial Pharmacy

1- Formulation.
2- Stability of Pharmaceutical Products.
3- Quality Control and Record-keeping.
4- Tablet manufacturing.
5- Capsules manufacturing.
6- Emulsions + Suspensions.
7- Ointments & Creams.
8- Parenteral Preparations.

B. Laboratory Quality Control

1) Official procedures, standards and references.
2) Extractions & identifications.
3) Quantitative techniques:

a) Spectroscopy: i) Ultraviolet/visible.
ii) Infra-Red,
b) Chromatography Principles & Practice
i) Thin layer chromatography.
ii) Column Chromatography
iii) Gas Liquid Chromatography
iv) High pressure liquid Chromatography.

4) Tablet and Capsule Evaluation:

i) Friability.
ii) Disintegration.
iii) Dissolution.
iv) Variation in weight.

5) Microbiological Tests
i) Microbiological assays
ii) Microbiological testing of sterile products.

C. Review of the Good Manufacturing Practices.

The Center for Environmental Health Sciences currently has two PhD's, Dr. Simon Kuttab and Dr. Ramzi Sansur, along with 2 B.Sc. Technicians. Another M. Sc. Technician is expected soon. In addition, it can draw on expertise from within and outside the University to offer a well-rounded, useful training program.

The administration of such a program can be the responsibility of the Center and of Birzeit University. Such a program would be highly useful and is needed in order to upgrade the quality of products and the overall development of the West Bank pharmaceutical companies.

PHARMACEUTICAL PRODUCTION IN GAZA STRIP

Gaza provides a lucrative market for West Bank business in general, and the pharmaceutical industry is no exception. An average of 18 - 23% of the production of each of the seven West Bank pharmaceutical firms is sold in the Gaza strip. Our interviews indicated that between 60 - 70% of the total drugs sold in Gaza are from the West Bank manufacturers, while about 20% are Israeli and 10% foreign imports.

The reaction of the West Bank firms to the idea of starting pharmaceutical production in Gaza strip has been negative throughout. The reason is that they feel they are adequately covering the Gaza market and that there is no need for additional drug firms in the occupied territories. They favour the existence of a smaller number of firms, less competition and more specialization. They also complained that the Israeli drug firms use agressive selling tactics in Gaza by offering large bonuses for pharmacies. This was not evident during our interviews. It seems that Israeli drug marketing practices have been toned down over the last year. Information relayed to us about uncontrolled drugs being sold in Gaza appears to be unfounded.

The general feeling among political forecasters is that the

future of Gaza, in case of any settlement of the Arab - Israeli conflict, is unclear. Also, the geographic situation of the strip makes it more difficult to transport goods at certain times when the Israeli occupation forces impose curfews or travel bans to and from Gaza. Hence the supply of pharmaceuticals can easily be cut at the will of the occupiers. This and the lucrative business aspect are two of the reasons behind the move to start pharmaceutical production in the Gaza strip.

Gaza, with a population of 500,000, about 300 practicing medical doctors and 60 pharmacies, may constitute a good market for any pharmaceutical firm. Unfortunately the situation is not as simple as it looks due to the tough competition that any Gaza pharmaceutical firm will face from West Bank, Israeli and foreign competitors.

Many attempts were made, since 1972, to start pharmaceutical production in the Gaza strip but failed due to the difficulties of obtaining a licence. Two licences were finally issued this year to the following firms:-

1) Gaza Pharmaceutical Co.
   headed by Mr. Usama Al - Rayyashi, B.Sc. Pharmacy, Cairo University.

2) Medical and Chemical Arab Supply Co.
   headed by Mr. Mohammad Ali Salha, B. Sc. Pharmacy and Diploma in Industrial Pharmacy and Chemical Engineering, Cairo University.

Both have acquired buildings to start their companies, and the Medical and Chemical Arab Supply Company is beginning to equip its factory with machinery.

The two companies intend to sell shares in the market but want to limit them to medical doctors and pharmacists. The Medical and Chemical Arab Supply Co. intends to have a capital of one million Jordanian Dinars. Its present building site has a total area of about 300 m^2 of which 185 m^2 is devoted to production and quality control and the remainder to offices and storage facilities. We observed the presence of machinery such as a polymixer and were told that liquid, powder and ointment filling machines were on the way.

Gaza strip has the expertise and the needed capital to start drug production. The two individuals currently establishing the firms in Gaza are reasonably qualified. The percentage sales of the West Bank products in Gaza exceeds 60%. Thus the establishment of any pharmaceutical firm in Gaza will economically affect the currently existing West Bank firms and may also affect the sales of Israeli and foreign products. Consideration of the geographic location of Gaza and its obscure political future justifies the need for the establishment of pharmaceutical firms in a way to become self-sufficient and less dependent on outside products. Such a step might also help the area economically

and provide jobs for a number of people.

However, the situation existing among the West Bank firms with respect to coordination of activities is likely to repeat itself in Gaza. The two licenced firms seem to be working independently with no coordination among themselves and with the West Bank firms. This situation will result in the creation of tough competition between the two firms and with the West Bank firms.

SUMMARY

The aim of this study was to evaluate the West Bank pharmaceutical sector and to work out recommendations that will help in upgrading their finished products as well as consolidating their activities.

The seven firms manufacture over 690 different products of which a small percentage is cosmetics and aerosols. Their facilities vary in area and extent of organization. Most companies have adequate equipment to meet their present needs.However, there is an immediate need for additional laboratory instruments to better control their products.

Most physicians, pharmacists and other concerned individuals interviewed had complaints about the poor quality and low efficacy of some products. All agree that there were improvements in the last two years.

The companies do not produce some classes of drugs such as cardiovascular preparations, enzymes and hormones which are supplied by Israeli and foreign manufacturers. Such drugs may not be profitable to manufacture or the companies cannot compete with the equivalent non West Bank drugs.

Consolidation of activity and possible unity is essential to the continued existance of the companies due to having a small competitive market as well as the current economic slump.

Guidelines for improvement have been presented which mostly center on better plant layout, better record keeping and documentation of every step followed in production, market follow-up and better control of their products.

An intensive training programme has been presented which can be sponsored by the Center for Environmental and Occupational Health Sciences at Birzeit University.

Two pharmaceutical companies have obtained licences to start drug production in the Gaza strip. They are, currently organizing and equipping to start production.

CONCLUSION

In this report we have attempted to present an objective evaluation of the firms. It should be understood that any comments or criticisms represent our own point of view and conclusions. None are directed towards any one company. In addition, what applies to one company may not apply to another.

Some of the products may be competitive in their quality with their foreign equivalents but the latter enjoy the confidence of physicians, pharmacists and the public as a whole. It is a fact that none of the companies are ideal or can compete with international companies in terms of organization and strict controls.

We are concerned about the degree of in-process and final quality control of the finished product and their stability and shelf life. When dealing with drugs we are dealing with life and, most importantly, human beings. Thus we cannot afford to have any substandard product on the market at any time.

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APPENDIX A

List of Available Equipment

Jordan Chemical Laboratory Co. Ltd.

Tablets and Capsules

Automatic tablet filling machine.
Fluid Bed Dryer.
Automatic Rotary Press.
Tablet & capsule counter (2)
Granulator.
Capsule filling machine.
Coating pan (2)
Capsule inserter.
Capsule tightening machine.
Dragee counting and filling machine.

Liquids

Simplex filling apparatus
bottle washing and drying machine.
Washing and filling machine.
Vacuum filling machine
Press filter.

Sterile Products

Reaction vessel for sterile products.
Bidistiller
Ampule printing machine
Millipore filter.
Ampule filling and sealing machine.

Ointments, Creams and Cosmetics

Tube filling machine.
Colloid mill.

Suppositories

Mixing machine for suppositories.

Jordan Chemical Laboratory Co. Ltd.
(Cont.)

Packing

Over wrapping machine.
Strip capsule packing machine.
Blister package machine.

Others

Spray washing equipment machine.
Mini sabra machine.
Air compressor.
Steam generator.
Powder filling machine.

Laboratory

Analytical balance.
U.V. Spectrophotometer.
Melting point apparatus.
PH meter.
Polarimeter.
Refractometer.
Disintegration time tester.
Centrifuge.
Visible light spectrophotometer.
Lovibond nesslerizer.
Muffle furnace.
Incubator.

Palestine Medical Co.

Tablets and Capsules

Tablet press small.
" " large (2)
" " deduster.
Small granulator.
Large granulator.
Tablet coating machine. (2)
Large mixer. (3)
Capsule sorter.
Capsule filling and closing machine.
Capsule counting machine.
Automatic capsule filling machine.
Large capacity coating machine.
Fluid bed dryer.

Palestine Medical Co.
(Cont.)

Automatic capsule filling machine.
Small mixer. (2)
Tablet machine.
Tablet counting machine.
Medium size mixer.

Liquids

Liquid filling machine. (large)
Liquid filling machine. (small)
Small and large mixer.
Bottle sorter.

Sterile Products

Ampule printing machine.
Millipore filter.
Autoclave.
Ampule filling machine.
Vial filling machine.
Vial closing machine.
Ampule washing and sterilizing unit.
Dry autoclave.
Steam pot.
Eye drop filling machine.
Automatic ampule machine.
Automatic vial machine.

Ointments and Creams

Ointment filling machine.
Large ointment mixer.
Small ointment mixer.
Manual ointment filling machine.
Tube filling machine.

Suppositories

Suppository machine.
Suppository packing machine.
Powder and suppository filling machine.

Packing

Small packing machine.
Labeling machine.
Sealing machine.

Palestine Medical Co.
(Cont.)

Others

Powder mill.
Small oven. (2)
Large oven.
Electric heater.
Small pump.
Large and small distillation apparatus.
Steam generator.
Large and small compressors.
Large washing machine.
Moving belts. (2)
Roller mill.

Laboratory Products

Magnetic stirrer with hot plate. (2)
UV/Vis. scanning spectrophotometer.
UV/Vis. spectrophotometer.
Analytical balance. (3)
PH meter.
Melting point apparatus.
Centrifuge.
Shaking water bath.
Oven.
Incubator.

Birzeit Pharmaceutical Co.

Tablets & Capsules Products

Tablet press.
Fluid bed dryer.
Drum mixer.
Granulator.
Varimixer.
Turbomixer.
Powder mixer.
Fitz mill (Powder)
Semi - Automatic capsule filling.
Automatic capsule filling.
Automatic spansule and capsule filling.
Single punch tablet press.
Tablet coating and polishing machine.

Birzeit Pharmaceutical Co.
(Cont.)

Liquids

High viscosity pump.
Colloid mill.
Bottle washing machine.
Bottle filling.
Bottle capping.
Laminar flow oven.
Bi-distiller.
Russel strainer.
Steam generator.
Liquid filling machine (E/D)
Semi automatic bottle capping.
Liquid filling apparatus.
Collovelox mill.

Ointments & Creams

Double jacket container (250 lt.)
Double jacket mixer (200 lt.)
Ointment and cream filling.
Ointment and liquid pump.
Homogenizer.

Sterile Products

Millipore filter unit.
Bench laminar flow hood.
Double door oven.
Vial filling machine.
Vial and ampule printing.
Liquid vial filling machine.
Liquid filtration apparatus.
Roof laminar flow.
Ampule testers (2 units)

Suppository Products

Suppository filling machine.
Suppository sealing machine.
Water bath.

Packing

Noak blistering.
Plastic sealing unit.
Automatic labeling.

Birzeit Pharmaceutical Co.
(Cont.)

Others

Electric oven.
Water softner.
Water boiler.
Powder suction.
Dehumidifier.
Powder deduster.
Mixer under vacuum.
Air compressor.
Dehumidifier unit.
Powder filling.
Powder filling (Semi-Automatic)

Laboratory Products

Tablet hardness tester.
Metler balance. (2)
Tripple beam balances. (3)
Double pan balances. (2)
U.V./Visible spectrophotometer.
PH meter.
PH meter.
Flask shaker.
Centrifuge.
Melting point apparatus.
Polarometer.
Tablet disintegrator.
Thermoplate heater and stirrer. (2)
Oven.
Furnace.
Millipore pumps.
Animal room.
Rabbit cages.
S.S. conditioners for rabbits.
Rabbit thermometer (electrical)
Plastic mice cages.
Oven.
Microscope.
Antibiotic zone reader.
Incubator.
Autoclave.
Water bath.
Millipore filtration unit.

Balsam Medical & Chemical Work Co. Ltd.: Not available.

Eastern Chemical Co.

Tablets and Capsules

Manual capsule filling machine.
Automatic capsule filling machine.
Granulator.
Dosing machine for antibiotics.
Rotary tablet press.
Sugar coating machine.
Powder mixing machine.

Liquids

Colloid mill.
Liquid filter.
Liquid filling machine.

Sterile Products

Eye drops filling machine.
Laminar flow hood.
Ultra violet water sterilizer.
Millipore filter.

Ointments & Creams

Tube filling machine.
Automatic ointment filling machine.

Packing

Blister packing machine.

Others

Powder filter.
Powder filling machine.
Electronic thermometer.
Manual suppository machine.
Strainer.

Laboratory

Ultra violet spectro-photo-meters.
PH meter.
Water baths.
Test tube shaker.
Magnetic mixer.
Incubator.
Metallic sterilizer.

Gama Chemical Company

Tablets and Capsules

Single punch tablet press.
Mixer drum.
Capsule filling machine.
Counting and filling machine.

Liquids

Liquid filling machine.

Ointments & Creams

Tube filling machine.

Aerosols

Semi automatic aerosol filling machine.

Packing

Blister packing machine.

Others

Drying oven.

APPENDIX B

List of Needed Equipment

PRODUCTION

JORDAN

Powder mixer.
Automatic labeling machine.
Carton coder.
Carton packing machine.

PALESTINE

Rotary table press.
Automatic carton coder.
Sieving and straining machine.
Double distiller.
Packing machine.
Automatic labeling machine.

JERUSALEM

Mixer.
Sifter.
Granulator.
Oscilator.
L/S tablet coating machine.
Effervescent tablet machine.
Automatic liquid filling machine.
Automatic heavy suspension filling machine.
Automatic belt for syrup.
Automatic plastic tube sealing machine.
Ampule printing machine.
Automatic carton coder.
Printing unit for blister packing machine.
Automatic feeder for blister packing machine.
Belt for production.
Electric generator.

LABORATORY

JORDAN

Infra red spectrophotometer.

Gas liquid Chromatograph.

PALESTINE

Gas liquid chromatograph.

JERUSALEM

Microscope.
Gas liquid chromatograph.
Vacuum pump.
Melting point apparatus.
Infrared spectrophotometer.

List of Needed Equipment
(Cont.)

PRODUCTION	LABORATORY
BIRZEIT	
Rotary tablet press.	Thin layer chromatography unit.
Automatic carton coder.	Laminar flow hood.
Electric generator.	UV./Visible scanning spectrophotometer.
	Dissolution rate apparatus.
	High pressure liquid chromatograph.
BALSAM *	
—	— —
EASTERN	
Suppository machine.	UV/Visible scanning spectrophotometer.
Spansule unit for capsule filling machine.	Senitive electronic balance.
GAMA	
Automatic capsule filling machine.	Tablet disintigration tester.
Rotary tablet press.	Tablet hardness tester.
Granulator.	Moisture determination apparatus.
Accurate scales.	Water bath.
	Incubator.

* The general directordid not provide us with the requested information.