

(2002 / 1423) 104-81 2 14 :

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11421

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1999

[3]

41

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(19)

(3.85

1.5

0.5

[4]

25

[5]

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-3

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85

1422

7

23

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1.5

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[7]

[8] (HACH DR/) 3000 Spectrophotometer)

-4

1 4

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(1)

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				10
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				16
				17
			(2)	18
			4)	19
			(2)	20
				21
				22
				23
-				
				1
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				7

....

[10] : [9]
[10]

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1-

" "

(Mann-Whitney Test) -
(Nonparametric Statistics)

7.02 : 8.60
.8.1 7.42

%4) 8.5 6.5
(2-) (

(7.59) .(3-) (7.71)
- .1-
0.05

(+)

(2)

					()					()				
0	0.05	0.05	114	52.3	2.6	1.02	30	13	42	159	117	0.13	7.67	1-
0	0.05	0.01	51	1.3	5.2	1.10	39	4.1	8	53	61	0.13	7.58	2-
0	0.05	0.02	62	5.3	2.4	1.05	19	4.1	14	51	62	0.13	7.47	3-
0	0.05	0.13	38	21.8	3.0	1.27	33.5	6	10	50	66	0.11	7.85	4-
0	0.30	0.03	64	24.5	1.5	1.29	24	13.7	25	120	103	0.11	7.88	5-
0	0.15	0.11	49	12.3	3.2	0.99	21.5	10.3	20	93	79	0.16	7.58	6-
0	0.05	0.06	31	5.3	1.8	1.06	47.5	3.2	3	30	72	0.15	7.71	7-
0	0.15	0.14	45	10	2.0	1.12	17	5.0	14	56	72	0.11	7.44	8-
0	0.10	0.15	28	1.8	3.3	1.12	24.5	1.2	7	24	57	0.19	7.02	9-
0	0.05	0.12	13	3.3	2.3	1.14	20.7	5.6	12	54	81	0.14	7.30	10-
0	0.05	0.07	27	19.8	3.3	0.96	22.7	4.8	10	53	59	0.17	7.81	11-
0	0.00	0.09	19	18.5	3.5	1.12	14.7	5.3	14	56	55	0.11	7.63	12-
0	0.05	0.02	16	9	2.7	1.17	32.5	3.2	6	28	60	0.10	7.96	13-
0	0.00	0.11	32	33	6.2	0.98	30.3	6.7	11	56	68	0.12	7.89	14-
0	0.10	0.14	44	11	2.6	0.62	36.5	3.8	7	34	70	0.09	7.75	15-
0	0.10	0.18	17	19.1	4.1	1.78	18.3	6.7	14	62	47	0.15	7.62	16-
0	0.10	0.19	40	15.5	2.5	1.11	51.5	4.8	10	46	89	0.16	8.10	17-
0	0.15	0.15	23	32.5	2.9	0.30	34.3	5.8	15	60	88	0.14	8.10	18-
0	0.15	0.16	15	2.3	3.5	1.17	34	4.4	7	34	59	0.14	8.20	19-
0	0.10	0.25	17	28.8	1	0.25	34.5	2.6	4	21	61	0.10	8.60	20-
0	0.20	0.17	17	1.3	2.8	0.68	44.5	4.0	2	22	55	0.14	7.59	21-
0	0.10	0.21	13	2.5	5.4	1.23	32.5	1.9	3	19	53	0.13	7.69	22-
0	0.05	0.28	28	25	2.2	0.96	24	6.5	10	52	72	0.16	7.79	23-
1 (0)	0.05 (12)	0.30 (0)	250 (0)	250 (0)	10 (0)	-0.6 1 (15)	-	30 (0)	75 (0)	300 (0)	700-100 (0)	5	8.5-6.5 (1)	(9)
0 (0)	0.05 (12)	0.30 (0)	250 (0)	250 (0)	10 (0)	-0.8 * 1.7 (1)	-	-	-	-	500 (0)	0.5 (0)	8.5-6.5 (1)	(10)

: 100 : / : (+)

:(.)

⁵ 12

0.8 .

:*

⁵ 33-26

1.7 .

:**

(+)

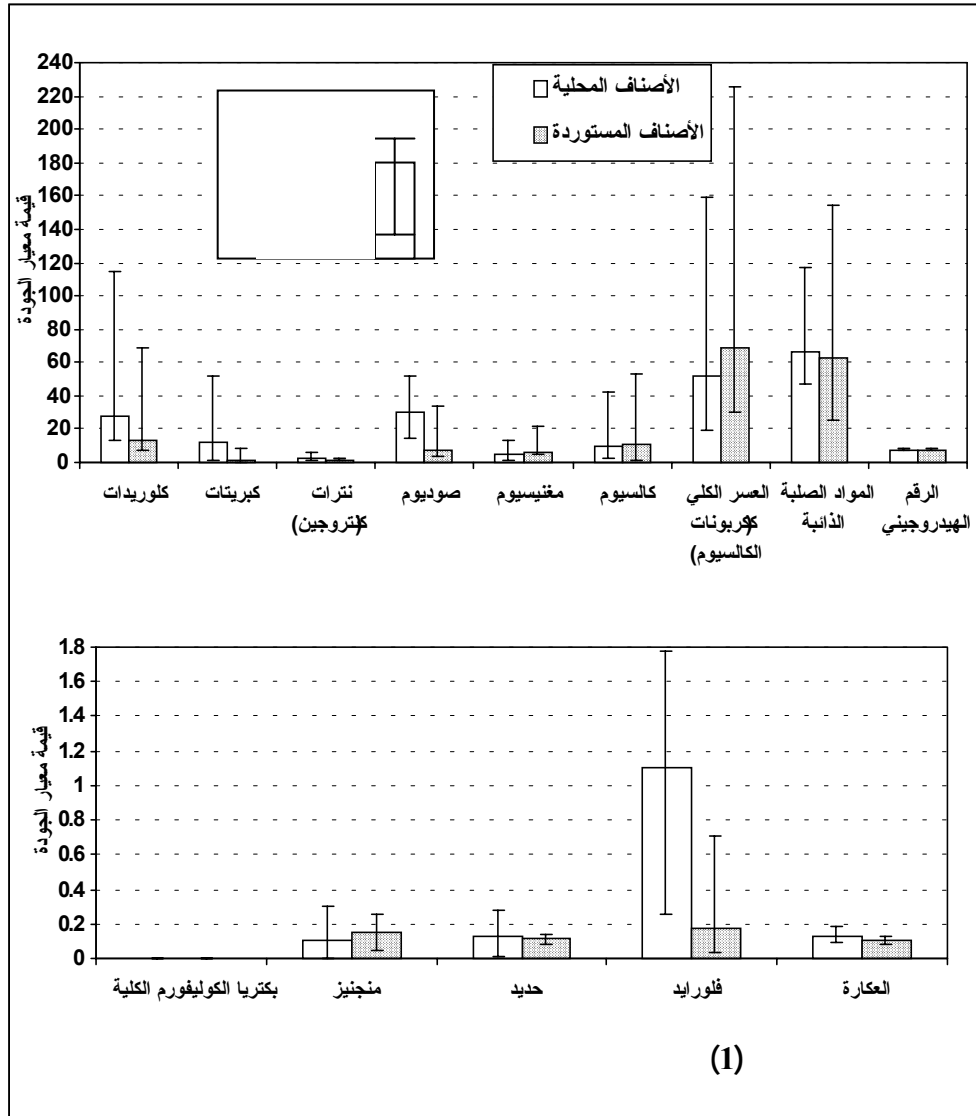
(3)

					()					()				
0	0.15	0.08	55	0.9	1.9	0.71	33.8	5.4	3	30	65	0.13	7.42	1-
0	0.20	0.11	13	5.4	1.7	0.19	3.3	6.4	33	109	52	0.13	8.16	2-
0	0.10	0.12	11	8.8	1.8	0.18	7.3	22.2	53	225	154	0.13	7.59	3-
0	0.25	0.13	69	2.5	1.5	0.14	25.8	5.9	8	44	66	0.10	7.56	4-
0	0.15	0.12	30	1.3	2.2	0.39	13.8	9.7	11	69	63	0.11	7.56	5-
0	0.05	0.10	7	0.5	1.8	0.09	4.8	5.2	1.2	49	25	0.10	7.72	6-
0	0.10	0.14	10	1.8	1	0.04	6.8	21.6	22	146	57	0.08	8.13	7-
1 (0)	0.05 (20)	0.30 (0)	250 (0)	250 (0)	10 (0)	-0.6 1 (0)	-	30 (0)	75 (0)	300 (0)	-100 700 (0)	5 8.5-6.5 (0)		(9)
0 (0)	0.05 (6)	0.30 (0)	250 (0)	250 (0)	10 (0)	-0.8 * 1.7 (0)	-	-	-	-	500 (0)	0.5 (0)	8.5-6.5 (0)	(10)

: 100 : / : (+)
 : () :
⁵ 12 0.8 . *
 .⁵ 33-26 1.7 .
 : **

(0.5)
 0.08 0.19 0.09
 . (1-) 0.13
 :
 (1-) 0.11 0.13

.0.05



$$117 \quad 47 \quad : \quad / \quad 154 \quad 25 \quad / \quad .(1- \quad)$$

$$(\quad / \quad 700)$$

$$1- \quad .(\quad / \quad 500)$$

$$/ \quad 63 \quad / \quad 66$$

$$- \quad .005$$

$$250 \quad [10] \quad /$$

$$. \quad / \quad 250$$

$$195 \quad 19 \quad :$$

$$.(1- \quad) \quad / \quad 225 \quad 30$$

$$(\quad / \quad 52)$$

92

%25 (/ 69)

/ 300

.(3 2)

42 2

:

.(1-) / 53 1.2

/

75

/

0.05

-

(/ 10)

.(/ 11)

1.2

:

22.2 5.2

/ 13.7

(1-)

.(1-) /

(/ 4.8)

%25 (/ 6.4)

.0.05

.3 2

(/ 30)

:

51.5 14.7

33.8 3.3

/

....

.(1-) /
(/ 30.3)

-
.005
(/ 7.3)

2-

[11]

. / 200

:

(1-)
/ 1.78 0.25

. / 0.71 0.04

(/ 1.1)

(/ 0.18)

15 (2-)

(%65)

(/ 1.0)

(%4)

.(/ 1.7)

0.6)

.(/

6

.(3-)

94

1.0

[12]

%65

/

15-12

/ 2

/ 8

[13]

(1-)

:

2.8

() /

6.2 1

2.2 1

/

/ 1.8

/

.0.05

/ 10

.3 2

(1-) :

1.3

/ 8.8 0.5

/ 52

(/ 12)

.(1-)

1.8)

- (/

.0.05

....

$$.(3 \ 2 \) / \ 250$$

$$(1- \) \ :$$

$$7 \ / \ 114 \ 13 \ . \ / \ 69 \\ (\ / \ 13) \ (\ / \ 28)$$

.0.05

$$.(3 \ 2 \) / \ 250$$

:

$$.(1- \) \ / \ 0.28 \ 0.13 \ 0.01 \\ / \ 0.14 \ 0.12 \ 0.08$$

-

.0.05

$$.(\ / \ 0.3)$$

$$(1- \) \ :$$

$$/ \ 0.3 \ 0.1 \ . \\ / \ 0.25 \ 0.15 \ 0.05$$

-

$$\%52 \) \ 12 \ (2- \) \ .0.05 \\ / \ 0.05 \ ($$

96

6

.(3-)

(%86)

3-1

(1989)

[13]

5-2

[13]

:

[14]

4.2

()

%1

%75 %1

(2)

%67

5-1

39-0

38-2

47-1

58-0

24-2

70-0

33-0

....

97

62-2

59-0

75-3

57-3

.57-0

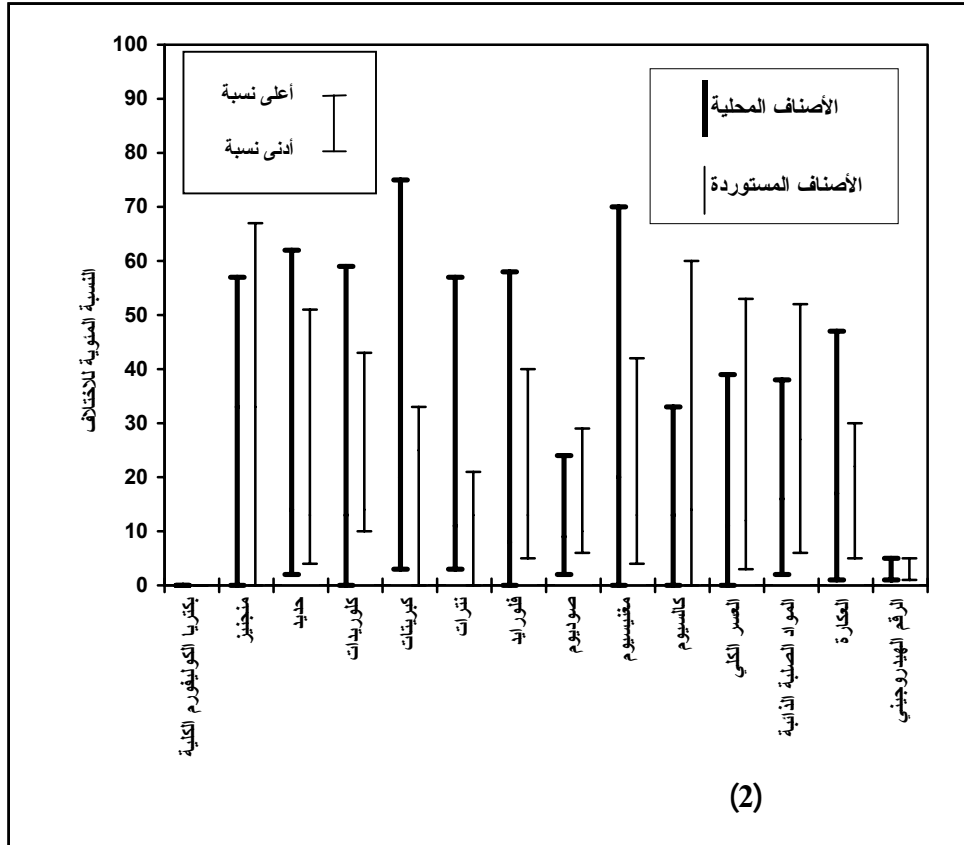
-0 53-3 52-6 30-5 5-1 :

.67-0 51-4 43-10 33-0 21-0 40-5 29-6 42-4 60

.%5 0

/

/



3,4

12

(3-)

....
.
(4-)

(3-)

. %12- %8+
%48+ %48-
%48- %25+ %62+
%46+ %43- %38+

.%925+
(=)
. / 0.11 0.01

(3-)

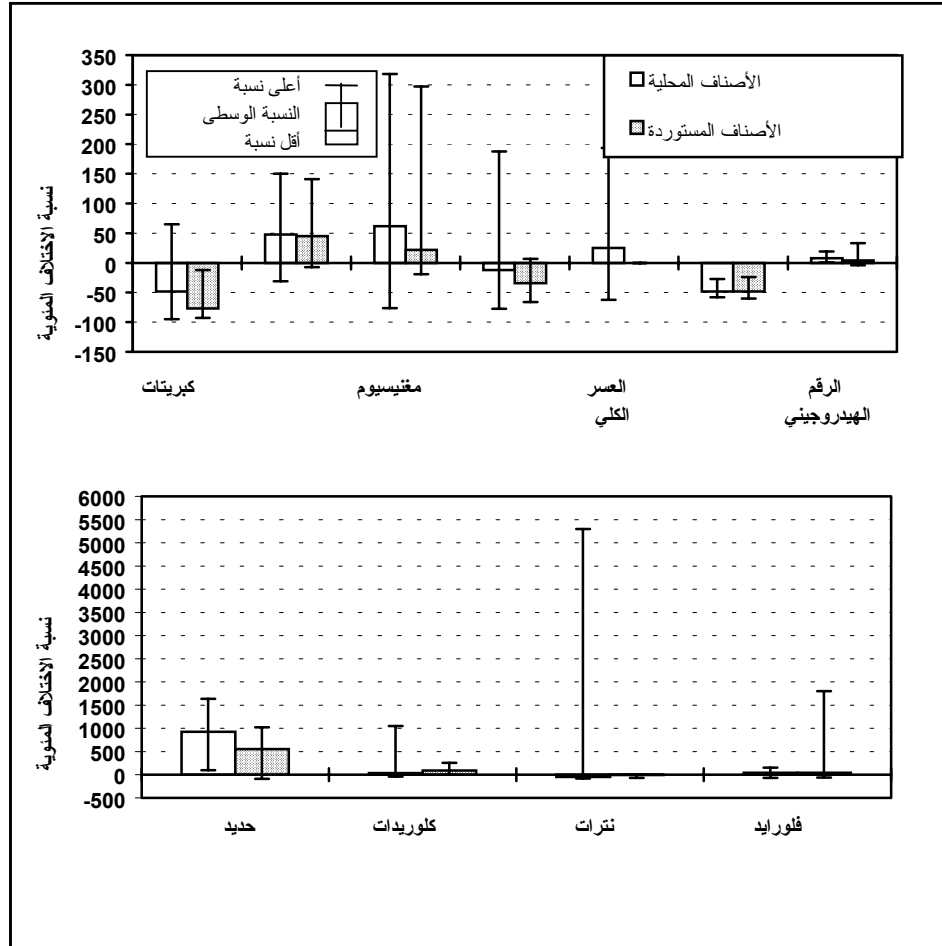
%5- %4+

. %555+
%45+ %77-

%48-

%34-

%22+

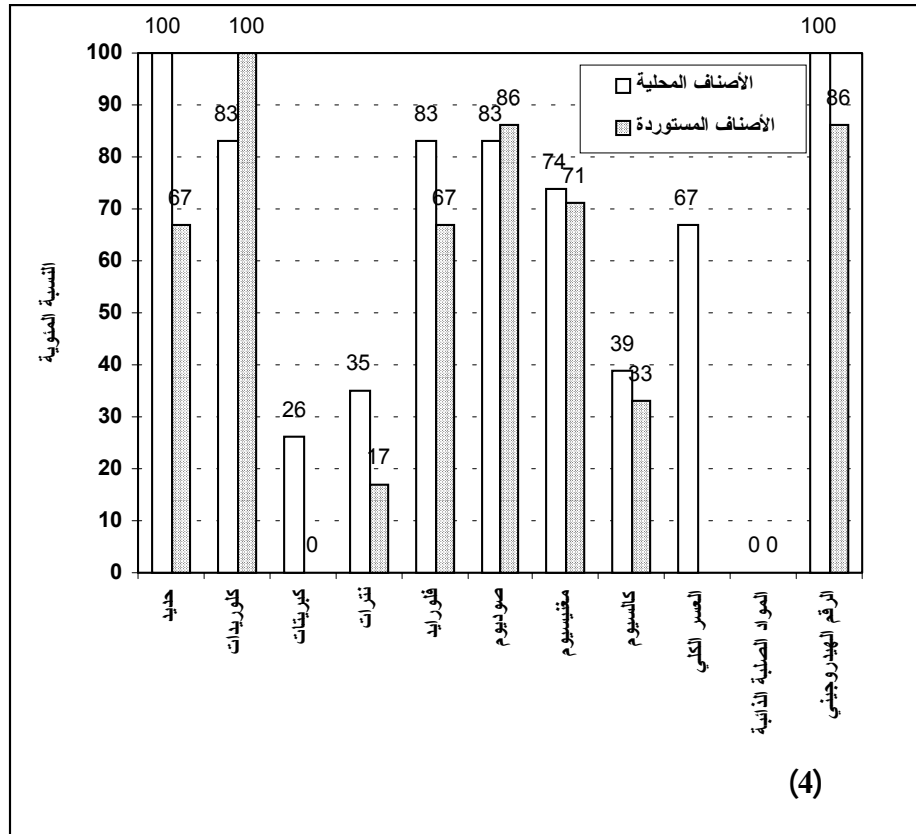


.%42+

%90+

(4-)

%26



102

-5

:

•

(7)

(23)

12
15

6

:

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•

....

103

%75 %0

/

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%67 %0

/

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-6

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Quality of Local and Imported Bottled Water in Saudi Arabia

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ABSTRACT. The water quality of twenty-three local and seven imported bottled water brands were evaluated during the first half of the year 1422H in the city of Riyadh-Saudi Arabia, and the results were compared with bottled water standards set by the Saudi Arabian Standards Organization, the International Bottled Water Association, and the U.S. Food and Drug Administration. Evaluation included the following physical, chemical, and microbiological parameters: pH, turbidity, total dissolved solids, total hardness, calcium, magnesium, sodium, fluoride, nitrates, sulfates, chlorides, iron, manganese, and total coliforms.

The levels of quality parameters of local and imported brands were in compliance with the different standards except for pH in one local brand, fluoride in 15 local brands, and manganese in 12 local and 6 imported brands. Fluoride concentrations in two local and 6 imported brands were below the lower limit recommended by the Saudi standards. Statistical analysis of data revealed that levels of Na, F, SO₄, and NO₃ in local brands were higher than in imported brands and statistically significant, with median's ratios ranging from 2 to 7.

Comparison of the results for the two bottles analyzed for the same brand revealed a substantial variation in the parameter values, ranging from 0% to 75%, and that the reported label values of most parameters do not reflect the real content of the bottles.

KEYWORDS: bottled water, water quality, bottled water standards.