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ORIGINAL ARTICLE

Common Environmental Allergens in the Kingdom of Saudi Arabia and Their Use in the Diagnosis of Allergic Diseases by Skin test

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ABSTRACT

Much human allergy is caused by a limited number of inhaled small proteins called allergens. Allergens are relatively large and complex molecules, such as pollens, molds, mites and house dust, which are capable of eliciting allergic reactions in susceptible persons. This study was conducted to identify the most common allergens in the kingdom of Saudi Arabia (KSA). Allergens were collected from different areas in the kingdom and used to prepare allergenic extracts to be used as diagnostic kits for diagnosis of allergy by skin prick test. The study included 494 patients diagnosed as truly allergic from five different areas in KSA; Jeddah, Riyadh, Al- Ehsaa, Al-Khobar, and Khamis Mushait. The study revealed that the mean prevalence of allergy in KSA is 24.7%. Using the locally prepared Saudi allergens, the most common allergens in KSA differed from one area to the other. They were Mites DF (49.1%), House dust mite (42.9%), and Mites DP (39.3%) in Al-Khobar, Mites DF (51.5%), Mite DP (48.5%), and house dust mite (39.8%) in Jeddah, Salsola kali (60.7%), Mites DP (52.3%), and Mites DF (48.6%) in Al-Ehsaa, Mites DP (56.7%), Mites DF (53.6%), Cat epithelium (46.4%) in Riyadh, and Salsola kali (54.7%), Mites DP (48%), and Prosopis (42.7%) in Khamis Mushait. These differences were attributed to many variable factors as environmental factors, geographical variation, and general change in indoor and outdoor environments. To assess the validity of Saudi allergenic extracts, they were compared to an imported kit; Canadian Omega kit. Although excellent validity was recorded for some allergens, validity of Saudi allergens was generally ranged from good to poor. This may be attributed to incomplete purity of collected allergens, different method for preparation and manufacturing, or may be due to different Saudi strain of the same allergen from the imported allergen. Adjustment of the methods of extraction, clarification, purification, and concentration of allergenic extracts was recommended. Reevaluation of methods and tools of allergy diagnosis in KSA keeping in consideration the common local allergens in the kingdom together with training of its physicians and doctors were also recommended.

INTRODUCTION

Allergic diseases are a major cause of illness in people of all ages. Each year the number of affecting population is increasing by 5% with as many as half of all those affected being children. [1] Exposure to indoor and outdoor allergens is an important risk factor for sensitization and allergic diseases, such as asthma and rhinitis. Most allergens are relatively small, highly soluble proteins that are carried on dry particles such as pollen grains or mite feces. On contact with the mucosa of airways, the allergen diffuses into the mucosa causing the manifestations of allergy in the susceptible patient.[2] Although allergic diseases are prevalent in KSA, no recent studies were conducted to identify the common environmental allergens in it. This study was conducted to identify the most common allergens in KSA environment. These allergens were used to prepare allergenic extracts to be used in the diagnosis of allergic diseases by skin prick test.To assess the validity of these locally prepared allergenic extracts, they were compared to an imported diagnostic kit (Canadian Omega kit) for diagnosis of allergic diseases.

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SUBJECTS AND METHODS

Subjects:

The study was included 494 patients from five different areas in Kingdom of Saudi Arabia (KSA) (103 from Jeddah, 97 from Riyadh, 107 from Al- Ehsaa,

112 from Al-Khobar, and 75 from Khamis Mushait) out of 2000 patients with suspected allergic diseases attending allergy clinics of Elaj Medical Centers in theses five areas (400 patients from each area).

For every patient the following were done:

1. Complete medical history was taken including Demographic data (name, age, sex and nationality), allergic symptoms and their duration, family history of allergy, and medications.
2. Complete physical examination.
3. Skin prick test (SPT).
4. Laboratory investigations as total IgE and complete blood count including absolute eosinophilic count.
5. Pulmonary function test and chest X-Ray were done for asthmatic patients.

Only patients complaining of allergic rhinitis, bronchial asthma, conjunctivitis, or urticaria and having positive skin prick test and high level of total IgE were included in the study. One hundred healthy individuals matching to patients in age and sex (20 from each area) were also included in the study.

Sample collection:

Allergens were collected from different areas in KSA. These allergens were house dust, mites, pollen, hair of cats, dogs, cows, sheep, camels, goats, horses, bird's features, fungal spores, different food allergens, Saudi tobacco, and insects such as cockroaches.

1. **Collection of air-borne pollens** was performed manually from the common plants in the area.
2. **Isolation of fungal spores** was done by culture plate method. In order to study indoor and outdoor mould spores, plates of Sabouraud's dextrose agar were exposed and then incubated at 28ºC for up to 5 days. Colonies were identified by colonial and microscopic morphology.
3. **Collection of cockroaches** was performed by vacuum from different places.
4. **Collection of animal hair** (cat, dog, cow, sheep, goat, camel, horse) was done by shaving of these animals.
5. **Collection of different types of feathers** from birds and poultry (chicken, duck).
6. **Collection of different common food items that may cause allergy** such as milk, fish, egg, fruits, nuts and other … etc.
7. **Collection of house dust** was done by collecting dust samples from urban and rural houses of both allergic and non-allergic patients of different age groups. These selected houses represent different socioeconomic classes of the community. Some use neither vacuum cleaners nor air-conditioning system, while the others use electrical cleaners and air-conditioning system during summer and winter seasons. Dust samples were collected regularly monthly from bedrooms, bedding, floor carpets, bed sheets, blankets, pillows and kitchens. Samples were collected by vacuuming one square meter of surface area for 4 minutes. The dust was collected in changeable vacuum cleaner bags. Each sample with its information sheet was enclosed in a plastic bag, tied securely and was sent to be examined in the laboratory within 24 hours of collection.
8. **Isolation of mites from house dust and mite counting:** Fine dust was removed through a 500µ mesh from each collected dust sample. Living mites was isolated from dust by a modified Berlese funnel with wire screening. Each sample of dust was placed on the top of the wire screening and covered with the lid of a Petri dish large enough to cover the dust. A small water filled beaker was placed beneath the funnel and a 60 watt lamp was hung at a distance of 20cm above the apparatus. After 24 hours, the small beaker was replaced by another one and the water surface of the first beaker was examined under a stereomicroscope (40X). Mites were picked up with a fine needle or a moistened camel hair brush no. 0.001 and were mounted in Hoyer's medium. After drying and hardening, slides were examined under a compound microscope using phase contrast illumination and the mites were identified.[3] Mites were then cultured under controlled laboratory conditions by keeping 2- 4 grams of fine house dust sample in 50ml glass beaker with a wide mouth (4.5cm) for 2-3 weeks at 25ºC and 75 % relative humidity (RH) in a special incubator. The mite's food was composed of dry powdered cheese which was dried in the ultraviolet furnace, dried eggs and yeast. The mixture of food was added in a ratio of 1:1:2 which strongly attracted the mites.[3] After 16 days the mites were picked up with a fine dissecting needle from this mixture and subcultured into fresh glass beakers and incubated. The prepared food was added. Humidity and temperature were adjusted and regulated by using a special incubator. The beaker was covered with five layers of soft paper to prevent mites from escaping and to forbid the invasion of predators and intrusion of other mite species.[4] A modified method for isolating HDM from house dust was also used aiming to improve mites concentration and to obtain them in an early pure form. In this method, house dust was cultured on culture media plates (composed of mixture of charcoal, gypsum, and water then dried and wood excelsior was added). Crushed maize was used for mites feeding. Plates were put in a relative humidity chamber with adjustable RH 73% and temperature 23°C for one month with regular observation. HDM were then collected by dropping components of each culture on the wire screening in 60cm diameter glass funnel. By the effect of heating of the electric lamp the mites migrated through wire screening and along the inner surface of the funnel to be collected and stored at -20°C till the time of use.

Preparation of allergenic extracts:

a) Preparation of mite antigen: Mite antigens were prepared using Coca Solution composed of Sodium Chloride10 gm, Sodium Bicarbonate 5.5gm, Phenol 8gm, and Distilled Water 2000ml.[5] The collected mites were dried and ground in a porcelain Mortar and pestle. The powdered mites were added to Coca's solution at a concentration of 1:50 (W/V) in screw capped Erlenmeyer flasks. The mixture was shaked in a shaker (Burrell Wrist-Action shaker Model 75) for 72 hours at room temperature. Then the extract solution was filtrated initially through Whatman no.1 filter paper and then through a sterilized Seitz filter using membrane filter with a pore size 0.22µ.The protein content of the mites was determined by the technique of colorimetric determination of protein based on the principle of Burette reaction.[6] The final antigen solutions were stored at 4ºC (valid for 12 months when stored at 2-8°C). These antigenic extracts were used for skin prick testing of allergic patients.

b) Preparation of other allergens: Weight per volume method was used.[5,7] This method was done by:

a. Addition of the crude allergenic material to the extracting fluid by ratio of 1gm allergenic material to 9ml of extracting fluid to get final antigen extract at a strength of 1/10 concentration.
b. The mixture was shaken thoroughly by the use of electric shaker for 2 hours for 2 successive days (one hour daily).
c. The mixture was initially filtered through Buckner's funnel with usual filter paper.
d. Secondary filtration was done by Seitz filter using special filter paper with pore size 0.22µ.
e. To check for sterility, extracts were smeared and stained with Gram stains and were cultivated on nutrient and blood agar (aerobic and anaerobic) to exclude bacterial contamination.
f. Each 1ml of this antigenic extract (standardized as 1:10 strength) contains 50,000 PNU (protein Nitrogen Unit).[8]
g. Dilution was made consequently with change in the content of PNU in the unit ml of antigenic extract.
h. Extracts were preserved at 2-8°C and valid for 12 months.

Skin Prick Test:

All the patients were asked to stop using antihistaminic and corticosteroids for a minimum of 96 hours before the test depending on their half lives. Skin prick test was done according to the protocol of Daniel et al.[9]. Only patients with positive SPT were included in the study. Application of the locally prepared Saudi allergens in the diagnosis of allergic diseases by skin prick tests was compared to an imported kit (Canadian Omega allergens).

Statistical analysis:

A statistical package of Epi-6-info 2000 program was used for data analysis. Validity of Saudi allergens (S) was compared to Omega allergens (O) by measuring both sensitivity and specificity of each allergen and calculating the L ratio (LR) +ve in allergic patients and LR -ve in healthy subjects. In allergic patients, the validity is considered excellent if LR +ve is more than 10, good if 5-10, fair if 2-5 and poor if it is less than 2. In healthy subjects, the validity is considered excellent if LR -ve is less than 0.1, good if 0.1-0.2, fair if 0.2-0.5 and poor if it is more than 0.5.

RESULTS

This study included 494 patients who were truly allergic suffering from allergic rhinitis, allergic bronchial asthma, allergic conjunctivitis or urticaria. The age ranged from 9-66 years. Males were 56% and females were 44%. These patients were selected from 2000 patients attending allergy clinics of Elaj medical centers in 5 different areas in KSA; Jeddah, Riyadh, Al-Khobar, Al-Ehsaa, and Khamis Mushait (400 patients from each clinic). One hundred healthy control individuals were also included.

The prevalence of allergic conditions in the five different areas was:

1- Al-Khobar: 112/400 (28.00%); 57.2% bronchial asthma, 33.6% allergic rhinitis, 3.7% allergic conjunctivitis and 5.5% urticaria.
2- Jeddah: 103/400 (25.75%); 33.8% bronchial asthma, 46.6% allergic rhinitis, 15.4% allergic conjunctivitis and 4.2 % urticaria.
3- Al-Ehsaa: 107/400 (26.75%); 61.3% bronchial asthma, 33.4% allergic rhinitis, 2.1% allergic conjunctivitis and 3.2% urticaria.
4- Riyadh: 97/400 (24.25%); 48.2% bronchial asthma, 39.6% allergic rhinitis, 5.2% allergic conjunctivitis and 7% urticaria.
5- Khamis Mushait: 75/400 (18.75%); 47.1% bronchial asthma, 49.2% allergic rhinitis,1.5% allergic conjunctivitis and 2.2% urticaria.

The mean prevalence of allergy in the study was 24.7%.

Table 1: Comparison of the percentages and mean diameters of SPT by both Saudi (S) and Omega (O) allergens in Al-Khobar (N=112).

Allergen	*S*			*O*			*T Test*	*P value*
	%	mean	± SD	%	Mean	± SD		
Mites DP	39.3	2.904	1.445	38.4	3.2	1.727	0.84	> 0.05
Mites DF	49.1	3.182	1.667	50.9	3.085	1.715	0.09	> 0.05
House dust	42.9	2.667	1.449	38.4	2. 545	1.32	0.18	>.0.05
Cockroach A	25.9	2.4	0.968	18.8	2.381	0.805	0.01	>0.05
Cockroach B	24.1	2.519	1.05	21.4	2.75	1.294	0.49	>0.05
Palm tree	25.9	2.552	1.682	13.4	2.8	2.111	0.67	> 0.05
Pigweed	17.0	2.211	0.918	9.8	2.545	1.809	0.57	>0.05
Plantain	9.8	2.0	0.0	6.3	2.286	0.756	1.0	>0.05
Prosopis	23.2	3.0	2.059	33.0	2.737	1.501	0.35	> 0.05
Mugwort	21.4	2.522	1.238	17.0	3.1	2.1	0.08	> 0.05
Rye grass	15.2	2.353	1.057	8.9	2.6	1.35	0.28	> 0.05
Timothy	11.6	2.462	1.198	8.9	2.4	1.265	0.01	> 0.05
Bermoda	8.0	2.222	0.667	9.8	4.909	2.879	3.0	> 0.05
Chenopodium	9.8	2.545	1.808	12.5	4.0	2.353	2.86	>.0.05
Salsola kali	28.6	2.938	1.435	37.5	3.512	2.087	1.77	> 0.05
Cat epithelium	31.3	2.611	1.42	16.1	3.222	1.833	1.82	> 0.05
Dog epithelium	33.0	2.611	1.498	16.0	2.556	1.504	0.02	> 0.05
Horse hair	12.5	3.0	2.184	9.8	3.636	2.157	0.53	>0.05
Goat epithel	25.0	2.214	0.833	17.9	2.2	0.616	0.01	>0.05
Sheep wool	29.5	2.606	1.273	25.0	2.214	0.833	1.44	> 0.05
Feathers mix	18.8	2.19	0.602	11.6	2.154	0.308	0.03	> 0.05
Candida	17.0	2.526	1.467	13.4	3.067	1.668	1.01	> 0.05
Asperigillus F	12.5	2.571	1.651	14.3	2.725	1.088	0.15	> 0.05
Alternaria A	12.5	2.143	0.535	8.0	2.444	1.333	0.64	> 0.05
Penicilluim N	3.6	3.0	1.155	10.7	2.333	0.778	1.75	>.0.05
Cladosporium	10.7	2.167	0.602	6.3	0.577	0.976	1.31	> 0.05
Fusarium	7.1	2.0	0.0	10.7	2.333	0.778	1.48	> 0.05
Chicken	0.9	2.0	0.0	0.9	2.0	0.0	0.0	> 0.05
Fishes Mix	32.1	3.378	0.924	32.1	2.111	0.667	2.0	> 0.05
Shrimps	38.4	2.512	0.985	37.5	2.048	0.309	8.51	< 0.05
Corn	10.7	2.0	0.0	12.5	2.154	0.308	1.0	> 0.05
Nut Mix	22.3	2.32	0.945	17.9	2.3	0.979	0.01	> 0.05
Sesame	10.7	2.0	0.0	9.8	2.364	0.809	1.49	> 0.05
Peanut	18.8	2.5	1.433	15.2	2.235	0.97	0.42	> 0.05
Soya	8.9	2.2	0.632	6.3	2.0	0.0	1.0	> 0.05
Egg whole	10.7	2.0	0.0	7.1	2.0	0.0	0.0	> 0.05
Cow milk	8.9	2.0	0.0	8.9	2.0	0.0	0.0	> 0.05
Cocoa	13.4	2.0	0.0	8.0	2.0	0.0	0.0	> 0.05
Banana	17.0	2.0	0.0	11.6	1.857	0.535	1.0	> 0.05

Table (2) shows comparison of the prevalence and mean diameters of positive SPT by both Saudi (S) and Omega (O) allergens in Jeddah. Significant P values were recorded for four allergens; mites DP, mites DF, rye grass, and chenopodium allergens. The table shows also that by using the locally prepared Saudi allergens the most prevalent allergen in Jeddah was mite DF (51.5%) followed by mite DP (48.5%), HDM (39.8%), American cockroach (cockroach A) (35.9%), cat epithelium (26.2%) and German cockroach (cockroach B) (25.2%) while the least prevalent allergens were banana (1%) and soya (0%). On the other hand, by using Omega allergens, the most prevalent allergens were mites DP (61.2%) followed by mites DF (53.4%), HDM (36.9%), cat epithelium (33%), cockroach B (32%) and cockroach A (20.4%) while the least prevalent allergens were cow milk (1.9%) and banana (1%).

Table 2: Comparison of the percentages and mean diameters of SPT by both Saudi and Omega allergens in Jeddah (N=103).

Allergen	*(S)*			*(O)*			*t Test*	*P value*
	%	mean	± SD	%	mean	± SD		
Mites DP	48.5	4.16	2.271	61.2	6.413	3.675	14.41	< 0.05
Mites DF	51.5	3.887	1.396	53.4	5.2	2.578	10.72	< 0.05
House dust	39.8	3.293	1.031	36.9	3.0	1.609	1.58	> 0.05
Cockroach A	35.9	3.486	1.609	20.4	2.952	1.203	1.75	> 0.05
Cockroach B	25.2	3.5	2.083	32.0	4.455	3.202	1.38	> 0.05
Palm tree	6.8	4.714	2.752	6.8	3.429	1.397	0.72	> 0.05
Pigweed	10.7	2.909	0.539	7.8	2.75	1.389	0.31	> 0.05
Plantain	5.8	2.167	0.408	8.7	3.222	1.093	2.63	> 0.05
Prosopis	15.5	3.688	1.778	19.4	3.75	1.618	0.01	> 0.05
Mugwort	17.5	2.667	0.97	8.7	2.556	1.424	3.68	> 0.05
Rye grass	17.5	3.222	2.016	13.6	5.0	2.542	4.88	< 0.05
Timothy	13.6	3.143	1.46	11.7	4.333	2.387	2.43	> 0.05
Bermoda	12.6	3.154	1.573	13.6	6.571	5.08	2.4	> 0.05
Chenopodium	5.8	2.333	0.516	10.7	3.455	1.214	4.56	< 0.05
Salsola kali	21.4	3.773	1.11	16.5	5.412	4.331	1.53	> 0.05
Cat epithelium	26.2	4.519	1.397	33.0	4.971	2.673	0.86	> 0.05
Dog epithelium	25.2	6.0	2.966	19.4	4.526	2.091	3.43	> 0.05
Horse hair	10.7	3.727	4.142	9.7	4.4	4.142	0.49	> 0.05
Goat epithelium	10.7	4.0	2.0	9.7	5.1	2.424	1.36	> 0.05
Sheep wool	15.5	2.938	0.998	11.7	3.167	1.193	0.31	> 0.05
Feathers mix	14.6	2.667	0.9	6.8	2.571	0.976	0.05	> 0.05
Candida	8.7	3.0	1.118	10.7	2.818	0.874	0.17	> 0.05
Asperigillus F	3.9	4.5	1.732	7.8	4.875	2.232	0.09	> 0.05
Alternaria A	8.7	4.0	2.449	4.9	4.0	2.0	0.0	> 0.05
Penicilluim N	9.7	3.1	1.449	9.7	4.7	2.541	2.99	> 0.05
Cladosporium	6.8	2.429	0.535	6.8	2.571	0.535	0.25	> 0.05
Fusarium	9.7	2.4	0.699	10.7	3.818	1.834	2.38	> 0.05
Chicken	3.9	2.25	0.5	5.8	3.0	0.894	2.27	> 0.05
Fishes Mix	7.8	4.75	2.659	6.8	3.286	1.254	1.77	> 0.05
Shrimps	13.6	4.214	3.142	11.7	5.5	3.425	1.0	> 0.05
Corn	3.9	2.25	0.5	2.9	3.333	1.155	2.94	> 0.05
Nut Mix	2.0	4.5	3.536	6.8	4.714	4.231	0.01	> 0.05
Sesame	4.9	2.2	0.447	7.8	3.5	2.268	0.97	> 0.05
Peanut	3.9	3.25	0.5	4.9	3.6	1.517	0.19	> 0.05
Soya	0.0	0.0	0.0	3.9	3.5	1.291	0.0	> 0.05
Egg whole	1.0	2.0	0.0	3.9	3.25	0.957	0.0	> 0.05
Cow milk	1.0	2.0	0.0	1.9	3.0	1.414	0.0	> 0.05
Cocoa	1.9	2.5	0.707	3.9	2.75	0.597	0.04	> 0.05
Banana	1.0	2.0	0.0	1.0	4.0	0.0	0.0	> 0.05

Table (3) shows comparison of the prevalence and mean diameters of positive SPT by both Saudi (S) and Omega (O) allergens in Al-Ehsaa. Significant P values were recorded among mites DP, house dust, cockroach B, mugwort and fusarium. The table shows also that by using the locally prepared Saudi allergens the most prevalent allergen in Al-Ehsaa was Salsola kali (60.7%) followed by mites DP (52.3%), mites DF (48.6%), Prosopis (46.7%), Cockroach A (41.1%) and Palm tree (37.4%) while the least prevalent allergens were chicken (3.7%) and coca (0.9%). On the other hand, by using Omega allergens, the most prevalent allergens were Salsola kali (64.5%) followed by mites DF (57%), mites DP (55.1%), Prosopis (54.2%), cockroach B (45.8%) and Chenopodium (43%) while the least prevalent allergens were chicken (7.5%) and coca (0.9%).

Table 3: Comparison of the mean diameters of SPT by both Saudi and Omega allergens in Al-Ehsaa (N=107).

Allergen	*S*			*O*			*t Test*	*P value*
	%	mean	± SD	%	mean	± SD		
Mites DP	52.3	2.982	0.726	55.1	3.322	0.753	6.07	< 0.05
Mites DF	48.6	3.019	0.82	57.0	3.016	0.866	0.01	> 0.05
House dust	32.8	2.941	0.649	29.9	2.195	1.4	8.18	< 0.01
Cockroach A	41.1	3.182	0.815	33.6	3.083	0.649	0.36	> 0.05
Cockroach B	36.4	3.077	0.87	45.8	3.449	0.818	4.25	< 0.05
Palm tree	37.4	3.475	0.847	39.3	3.833	0.881	3.51	> 0.05
Pigweed	18.7	3.3	0.733	21.5	3.333	0.917	0.02	> 0.05
Plantain	16.8	3.444	0.616	26.2	3.222	0.751	1.05	> 0.05
Prosopis	46.7	3.44	0.837	54.2	3.379	0.875	0.14	> 0.05
Mugwort	26.2	2.815	0.736	29.9	3.273	0.801	5.22	< 0.05
Rye grass	17.8	2.947	0.848	20.6	3.136	0.71	0.60	> 0.05
Timothy	24.3	3.0	0.49	29.0	3.323	0.832	1.82	> 0.05
Bermoda	23.4	3.2	0.764	32.7	3.229	0.77	0.02	> 0.05
Chenopodium	34.6	2.892	0.567	43.0	3.174	0.797	3.29	> 0.05
Salsola kali	60.1	3.754	1.0	64.5	4.0	1.007	2.00	> 0.05
Cat epithelium	23.4	3.32	0.9	33.6	3.5	0.91	0.58	> 0.05
Dog epithelium	15.0	3.438	1.094	23.4	3.16	0.189	0.75	> 0.05
Horse hair	10.3	2.91	0.70	12.1	2.692	0.63	0.64	> 0.05
Goat epithelium	9.6	2.952	0.74	23.4	3.12	0.726	0.60	> 0.05
Sheep wool	15.9	2.706	0.686	19.6	2.714	0.717	0.01	> 0.05
Feathers mix	9.3	2.455	0.522	14.0	2.733	0.799	1.01	> 0.05
Candida	20.6	2.773	0.528	23.4	2.64	0.7	0.53	> 0.05
Asperigillus F	5.6	2.833	0.408	10.3	3.091	0.701	0.67	> 0.05
Alternaria A	7.5	3.125	0.641	11.2	2.667	0.492	3.72	> 0.05
Penicilluim N	15.9	2.706	0.772	15.9	2.824	0.728	0.29	> 0.05
Cladosporium	10.3	2.909	0.701	11.2	3.077	0.862	0.27	> 0.05
Fusarium	5.6	2.333	0.516	7.5	3.125	0.641	6.13	< 0.05
Chicken	3.7	3.0	0.816	7.5	3.125	0.641	0.09	> 0.05
Fishes Mix	17.8	2.579	0.692	22.4	3.0	0.722	3.73	> 0.05
Shrimps	28.0	2.645	0.839	25.2	2.926	0.73	1.83	> 0.05
Corn	20.6	2.87	0.869	22.4	2.667	0.67	0.73	> 0.05
Nut Mix	8.4	2.667	0.50	10.3	2.636	0.809	0.01	> 0.05
Sesame	13.1	2.714	0.469	17.8	2.737	0.653	0.01	> 0.05
Peanut	10.3	2.818	0.603	10.3	2.545	0.522	0.51	> 0.05
Soya	15.0	2.625	0.619	15.9	2.529	0.624	0.20	> 0.05
Egg whole	14.0	2.6	0.737	12.1	2.692	0.751	0.11	> 0.05
Cow milk	9.3	2.5	0.527	11.2	2.5	0.674	0.0	> 0.05
Cocoa	0.9	2.0	0.0	0.9	2.0	0.0	0.0	> 0.05
Banana	9.3	2.1	0.316	11.2	2.5	0.522	1.14	> 0.05

Table (4) shows comparison of the prevalence and mean diameters of positive SPT by both Saudi (S) and Omega (O) allergens in Riyadh. Significant P values were recorded for cockroach A, prosopis, rye grass, timothy, bermoda, chenopodium, cat epithelium, dog epithelium and aspergillius F. The table shows also that by using the locally prepared Saudi allergens the most prevalent allergen in Riyadh was mites DP (56.7%) followed by mites DF (53.6%), Cat epithelium (46.4%), Salsola kali (42.3%), Prosopis (37.1%) and Cockroach B (36.1%) while the least prevalent allergens were coca (4.8%) and goat epithelium (3.1%). On the other hand, by using Omega allergens, the most prevalent allergens were mite DP (56.7%) followed by mites DF (51.5%), Cat epitheliuum (49.5%), Salsola kali (40.2%), cockroach B (39.2%) and Prosopis (37.1%) while the least prevalent allergens were Penicilluim N (3.1%) and goat epithelium (2.1%).

Table 4: Comparison of the percentages and mean diameters of SPT by both Saudi and Omega allergens in Riyadh (N=97).

Allergen	*S*			*O*			*t Test*	*P value*
	%	mean	± SD	%	mean	± SD		
Mites DP	56.7	5.509	1.562	56.7	5.821	1.83	0.93	> 0.05
Mites DF	53.6	5.269	1.43	51.5	5.58	1.727	1.0	> 0.05
House dust	29.9	5.793	1.346	27.8	6.074	1.346	0.5	> 0.05
Cockroach A	33.0	6.781	1.581	27.8	5.429	1.874	9.19	< 0.01
Cockroach B	36.1	5.385	2.391	39.2	5.395	1.498	0.0	> 0.05
Palm tree	28.9	5.103	1.655	25.8	6.2	1.291	2.96	> 0.05
Pigweed	20.6	6.2	1.281	23.7	6.348	1.873	0.9	> 0.05
Plantain	32.0	5.226	1.499	35.1	5.765	1.615	1.93	> 0.05
Prosopis	37.1	6.0	1.639	37.1	6.824	1.487	4.84	< 0.05
Mugwort	22.7	5.364	1.432	19.6	6.0	1.333	2.26	> 0.05
Rye grass	28.9	5.857	1.533	29.9	7.586	1.119	23.7	<0.001
Timothy	32.0	5.774	1.499	27.8	6.667	1.468	6.1	< 0.01
Bermoda	28.9	5.643	1.42	28.9	7.286	1.357	19.6	<0.001
Chenopodium	32.0	5.781	1.601	27.8	6.667	1.359	5.14	< 0.05
Salsola kali	42.3	6.683	1.457	40.2	7.231	1.87	2.15	> 0.05
Cat epitheli	46.4	5.644	1.417	49.5	6..857	1.633	14.68	<0.001
Dog epitheli	23.7	6.087	1.276	16.5	5.0	1.266	6.9	< 0.05
Horse hair	8.2	5.5	1.414	7.2	5.333	1.033	0.06	> 0.05
Goat epithel	3.1	6.0	0.0	2.1	6.0	0.0	0.0	> 0.05
Sheep wool	28.9	5.107	1.524	28.9	4.679	1.02	1.24	> 0.05
Feathers mix	14.4	4.786	1.122	9.3	4.444	0.882	0.6	> 0.05
Candida	25.8	4.64	1.075	23.7	5.091	1.306	1.68	> 0.05
Asperigillus F	9.3	4.333	1.0	8.2	6.0	1.512	7.36	< 0.05
Alternaria A	11.3	4.8	1.033	10.3	4.6	0.966	0.2	> 0.05
Penicilluim N	5.2	5.6	1.673	3.1	6.0	2.0	0.09	> 0.05
Cladosporium	10.3	5.333	1.414	12.4	5.5	1.243	0.08	> 0.05
Fusarium	10.3	5.2	1.398	8.2	5.5	1.414	0.2	> 0.05
Chicken	21.6	4.81	1.25	19.6	4.421	1.261	0.96	> 0.05
Fishes Mix	13.4	4.692	1.109	14.4	4.768	1.122	0.05	> 0.05
Shrimps	28.9	4.821	1.249	23.7	4.696	1.146	0.14	> 0.05
Corn	7.2	4.857	1.574	9.3	4.111	0.782	1.55	> 0.05
Nut Mix	14.4	4.071	0.616	17.5	4.176	0.728	0.18	> 0.05
Sesame	9.3	4.222	0.667	13.4	4.308	0.751	0.08	> 0.05
Peanut	18.6	4.278	0.826	18.6	4.0	0.594	1.34	> 0.05
Soya	9.3	4.111	0.782	10.3	4.0	0.0	0.43	> 0.05
Egg whole	13.4	4.462	0.877	10.3	4.0	0.0	1.9	> 0.05
Cow milk	13.4	4.692	1.109	7.2	4.571	0.976	0.06	> 0.05
Cocoa	4.8	4.8	1.033	5.2	4.4	0.894	0.54	> 0.05
Banana	18.6	4.353	0.786	13.4	4.385	0.961	0.01	> 0.05

Table (5) shows comparison of the prevalence and mean diameters of positive SPT by both Saudi (S) and Omega (O) allergens in khamis Moshait. Significant P value was recorded for only one allergen, Alternaria A. The table shows also that by using the locally prepared Saudi allergens the most prevalent allergen in khamis Moshait was Salsola kali (54.7%) followed mite DP (48%), Prosopis (42.7%), palm tree (40%), mite DF (39.7%) and Cockroach B (36%) while the least prevalent allergens were chicken (4%) and coca (0%). On the other hand, by using Omega allergens, the most prevalent allergens were Salsola kali (56%) followed by mite DP (53.3%), mite DF (45.3%), Prosopis (45.3%), palm tree (44%) and cockroach B (41.3%) while the least prevalent allergens were chicken (5.3%) and coca (1.3%).

Table 5: Comparison of the percentages and mean diameters of SPT of both Saudi (S) and Omega allergens (O) in khamis Moshait (N=75).

Allergen	*S*			*O*			*t test*	*P value*
	%	mean	± SD	%	Mean	± SD		
Mites DP	48.0	3.051	0.724	53.3	3.244	0.799	1.28	>0.05
Mites DF	39.7	3.086	0.853	45.3	3.093	0.868	0.01	>0.05
House dust	33.3	2.804	0.618	30.7	2.826	0.984	0.06	>0.05
Cockroach A	33.3	3.269	0.724	32.0	3.0	0.59	142	>0.05
Cockroach B	36.0	3.259	0.903	41.3	3.438	1.014	0.50	>0.05
Palm tree	40.0	3.552	0.783	44.0	3.667	0.924	1.09	>0.05
Pigweed	12.0	3.444	0.527	10.7	3.25	1.389	0.37	>0.05
Plantain	10.7	3.50	0.756	13.3	3.30	1.059	0.20	>0.05
Prosopis	42.7	3.5	0.803	45.3	3.321	0.983	0.69	>0.05
Mugwort	22.7	2.765	0.664	25.3	3.316	1.003	3.68	>0.05
Rye grass	14.7	2.818	0.751	14.7	3.091	0.539	0.96	>0.05
Timothy	18.7	3.214	0.426	18.7	3.385	1.044	0.55	>0.05
Bermoda	28.0	3.25	0.639	29.3	3.318	1.041	0.25	>0.05
Chenopodium	34.7	2.731	0.533	38.7	2.90	0.759	0.90	>0.05
Salsola kali	54.7	3.707	1.031	56.0	4.071	1.045	2.55	>0.05
Cat epithelium	33.3	3.417	0.974	32.0	3.52	1.046	0.13	>0.05
Dog epithelium	10.7	3.375	0.916	13.3	3.0	0.943	0.72	>0.05
Horse hair	8.0	3.0	0.632	8.0	2.50	0.837	1.36	>0.05
Goat epithelium	18.7	3.0	0.679	20.0	2.929	0.73	0.07	>0.05
Sheep wool	20.0	2.643	0.745	17.0	2.5	0.522	0.31	>0.05
Feathers mix	14.7	2.8	0.919	13.3	2.444	0.726	0.86	>0.05
Candida	24.0	2.667	0.485	25.3	2.722	0.669	0.08	>0.05
Asperigillus F	5.3	2.75	0.50	5.3	3.167	0.983	0.60	>0.05
Alternaria A	10.7	3.143	0.69	9.3	2.429	0.535	4.68	<0.05
Penicilluim N	17.3	2.7	0.866	17.3	2.833	0.835	0.06	>0.05
Cladosporium	10.7	2.875	0.641	14.7	2.80	0.789	0.05	>0.05
Fusarium	4.0	2.667	0.577	5.3	3.25	0.957	0.85	>0.05
Chicken	4.0	3.333	0.577	5.3	3.25	0.957	0.02	>0.05
Fishes Mix	21.3	2.412	0.618	21.3	2.813	0.544	3.89	>0.05
Shrimps	28.0	2.60	0.940	25.3	3.105	1.197	2.16	>0.05
Corn	20.0	2.933	0.458	21.3	2.438	0.512	7.99	>0.05
Nut Mix	6.7	2.667	0.516	8.0	2.286	0.488	1.87	>0.05
Sesame	17.3	2.667	0.492	16.0	2.667	0.651	0.0	>0.05
Peanut	8.0	2.833	0.753	8.0	2.833	0.48	0.0	>0.05
Soya	14.7	2.5	0.522	17.3	2.417	0.669	0.11	>0.05
Egg whole	14.7	2.333	0.50	13.3	2.375	0.518	0.03	>0.05
Cow milk	9.3	2.375	0.518	9.3	2.571	0.787	0.33	>0.05
Cocoa	0.0	0.0	0.0	1.3	2.0	0.0	0.0	>0.05
Banana	12.0	2.111	0.333	10.7	2.50	0.535	3.33	>0.05

Validity of Saudi allergens (S) was determined by comparing them to Omega allergens (O). Sensitivity and specificity were measured for each allergen and the LR +ve in allergic patients and LR-ve in healthy subjects were calculated. Table (6) shows sensitivity and specificity of Saudi allergens compared to Omega allergens in Al-Khobar. Excellent specificity was recorded for 6 allergens; timothy, bermoda, horse hair, chicken, sesame and cow milk, while excellent sensitivity was recorded only for chicken allergen. Chicken allergen was the only allergen that recorded both excellent sensitivity and specificity.

Table 6: Validity of Saudi allergens compared to the Canadian Omega allergens in Al-Khobar:

Allergen	Sensitivity	Specificity	LR + ve	Clinical Decision	LR - ve	Clinical Decision
Mites DP	69.8	79.7	3.4	Fair	0.4	Fair
Mites DF	71.9	74.6	2.8	Fair	0.4	Fair
House dust	76.8	78.3	3.5	Fair	0.3	Fair
Cockroach A	66.7	83.5	4.1	Fair	0.4	Fair
Cockroach B	62.5	86.4	4.6	Fair	0.4	Fair
Palm tree	86.7	83.5	5.3	Good	0.16	Good
Pigweed	72.7	89.1	6.7	Good	0.31	Fair
Plantain	57.1	93.3	8.5	Good	0.46	Fair
Prosopis	51.4	90.7	5.5	Good	0.54	Poor
Mugwort	52.6	84.9	3.5	Fair	0.56	Poor
Rye grass	50.0	88.2	4.2	Fair	0.6	Poor
Timothy	70.0	94.1	11.9	Excellent	0.39	Fair
Bermoda	57.1	95.0	11.4	Excellent	0.45	Fair
Chenopodium	42.9	94.9	8.4	Good	0.6	Poor
Salsola kali	28.6	00.0	0.29	Poor	∞	Poor
Cat epithelium	72.2	76.6	3.1	Fair	0.4	Fair
Dog epithelium	83.3	76.6	2.6	Fair	0.22	Fair
Horse hair	81.8	95.1	16.7	Excellent	0.19	Good
Goat epithelium	55.0	81.5	2.9	Fair	0.6	Poor
Sheep wool	71.0	84.5	4.61	Fair	0.34	Fair
Feathers mix	46.2	84.9	3.1	Fair	0.6	Poor
Candida	46.7	87.6	3.8	Good	0.6	Poor
Asperigillus F	43.8	92.7	6.0	Good	0.47	Fair
Alternaria A	33.3	89.3	3.1	Fair	0.8	Poor
Penicilluim N	16.7	98.0	8.4	Good	0.9	Poor
Cladosporium	57.1	92.4	7.5	Good	0.47	Poor
Fusarium	25.0	95.0	5.0	Good	0.8	Poor
Chicken	100.0	100.0	∞	Excellent	0.0	Excellent
Fishes Mix	66.7	84.2	4.2	Fair	0.4	Fair
Shrimps	71.4	81.4	3.8	Fair	0.4	Fair
Corn	42.9	93.9	7.0	Good	0.61	Poor
Nut Mix	00.0	100.0	0.0	Poor	1.0	Poor
Sesame	72.7	96.0	18.2	Excellent	0.3	Fair
Peanut	76.5	91.6	9.1	Good	0.26	Fair
Soya	14.3	91.4	1.7	Poor	0.9	Poor
Egg whole	50.0	62.3	6.5	Good	0.54	Poor
Cow milk	60.0	96.1	15.4	Excellent	0.42	Fair
Cocoa	55.6	90.3	5.7	Good	0.49	Fair
Banana	76.9	90.9	8.5	Good	0.3	Fair

LR –ve: Excellent < 0.1, Good 0.1-0.2, Fair 0.2-0.5, Poor ≥0.5.
LR +ve: Excellent ≥ 10, Good 5-10, Fair 2-5, Poor < 2.

Table (7) shows sensitivity and specificity of Saudi allergens compared to Omega allergens in Jeddah. The highest sensitivity test was recorded for dog epithelium (90%), while the highest specificity was recorded for aspergillusF ; nut mix and soya allergen (100%). Excellent specificity of Saudi allergens was recorded for10 allergens; palm tree, prosopis, cat epithelium, horse hair, goat epithelium, sheep wool, aspergillus F, cladosporium, corn and coca, while excellent sensitivity was recorded only for aspergillus F allergen. Aspergillus F was the only allergen that recorded both excellent sensitivity and specificity.

Table 7: Validity of Saudi allergens compared to the Canadian Omega allergens in Jeddah

Allergen	Sensitivity	Specificity	LR + ve	Clinical Decision	LR - ve	Clinical Decision
Mites DP	69.8	85.0	4.65	Fair	0.36	Poor
Mites DF	85.5	87.5	6.84	Good	0.17	Good
House dust	68.4	76.9	2.96	Fair	0.41	Fair
Cockroach A	81.0	75.6	3.31	Fair	0.25	Fair
Cockroach B	63.6	92.9	8.96	Good	0.39	Fair
Palm tree	57.1	96.9	18.4	Excellent	0.44	Fair
Pigweed	60.0	91.6	7.14	Good	0.44	Poor
Plantain	22.2	95.6	5.10	Good	0.81	Good
Prosopis	60.0	95.2	12.5	Excellent	0.42	Fair
Mugwort	44.4	85.1	2.98	Fair	0.65	Poor
Rye grass	57.1	88.8	5.10	Good	0.48	Fair
Timothy	33.3	89.0	3.04	Fair	0.68	Poor
Bermoda	42.9	92.1	5.40	Good	0.62	Poor
Chenopodium	22.2	95.7	5.20	Good	0.81	Poor
Salsola kali	58.9	86.1	4.20	Good	0.48	Fair
Cat epithelium	76.5	98.6	54.6	Excellent	0.24	Fair
Dog epithelium	90.0	90.4	9.40	Good	0.11	Good
Horse hair	60.0	94.6	11.1	Excellent	0.42	Fair
Goat epithelium	70.0	95.7	16.3	Excellent	0.31	Fair
Sheep wool	66.7	91.1	7.5	Excellent	0.37	Fair
Feathers mix	00.0	84.3	0.00	Poor	1.20	Poor
Candida	27.3	93.5	4.20	Fair	0.78	Poor
Asperigillus F	50.0	100.0	∞	Excellent	∞	Excellent
Alternaria A	80.0	94.9	3.90	Fair	0.21	Fair
Penicilluim N	50.0	94.6	9.30	Good	0.53	Poor
Cladosporium	42.9	95.8	10.2	Excellent	0.59	Poor
Fusarium	36.4	93.5	5.60	Good	0.70	Poor
Chicken	16.7	96.9	5.39	Good	0.80	Poor
Fishes Mix	28.6	93.8	4.60	Fair	0.80	Poor
Shrimps	50.0	91.2	5.90	Good	0.55	Poor
Corn	33.3	97.0	11.1	Excellent	0.70	Poor
Nut Mix	00.0	100.0	0.00	Poor	1.00	Poor
Sesame	25.0	96.8	7.80	Good	0.80	Poor
Peanut	20.0	96.9	6.50	Good	0.80	Poor
Soya	0.00	100.0	0.00	Poor	1.00	Poor
Egg whole	00.0	99.0	0.00	Poor	1.00	Poor
Cow milk	00.0	99.0	0.00	Poor	1.01	Poor
Cocoa	25.0	99.0	25.0	Excellent	0.80	Poor
Banana	00.0	99.0	0.00	Poor	1.01	Poor

LR –ve: Excellent < 0.1, Good 0.1-0.2, Fair 0.2-0.5, Poor ≥0.5.
LR +ve: Excellent ≥ 10, Good 5-10, Fair 2-5, Poor < 2.

Table (8) shows sensitivity and specificity of Saudi allergens compared to Omega allergens in Al-Ehsaa. Excellent specificity of Saudi allergens was recorded for 30 allergens including mite DF, cockroach, palm tree, pigweed, plantain, timothy, bermoda, chenopodium, cat epithelium, dog epithelium, horse hair, goat epithelium, sheep wool, feathers mix, candida, aspergillius F, alternaria A, penicillium N, cladosporium, fusarium, chicken, fish mix, shrimps, corn, nut mix, sesame, peanut, egg whole, cow milk and banana. On the other hand no excellent sensitivity was recorded for any allergen.

Table 8: Validity of Saudi allergens compared to the Canadian Omega allergens in Al-Ehsaa

Allergen	Sensitivity	Specificity	LR + ve	Clinical decision	LR - ve	Clinical Decision
Mites DP	83.1	70.9	2.9	Fair	0.2	Fair
Mites DF	93.6	97.8	38.0	Excellent	0.11	Good
House dust	87.5	90.7	9.4	Good	1.4	Poor
Cockroach A	83.3	80.3	9.2	Good	0.21	Fair
Cockroach B	73.5	94.8	14.1	Excellent	0.17	Good
Palm tree	85.7	93.9	14.1	Excellent	0.15	Good
Pigweed	65.2	94.1	11.1	Excellent	0.4	Fair
Plantain	60.7	98.7	46.7	Excellent	0.39	Fair
Prosopis	75.9	87.8	5.9	Good	0.3	Fair
Mugwort	65.6	92.0	8.2	Good	0.37	Fair
Rye grass	59.1	59.1	8.3	Good	0.44	Poor
Timothy	74.2	96.1	19.0	Excellent	0.3	Fair
Bermoda	62.9	95.8	14.9	Excellent	0.39	Fair
Chenopodium	71.7	93.4	10.8	Excellent	0.3	Fair
Salsola kali	88.2	87.2	6.9	Good	0.14	Good
Cat epithelium	66.7	66.7	47.6	Excellent	0.3	Poor
Dog epithelium	64.0	100.0	∞	Excellent	0.6	Poor
Horse hair	69.2	97.9	32.9	Excellent	0.3	Fair
Goat epithelium	72.0	96.3	19.5	Excellent	0.3	Fair
Sheep wool	66.7	96.5	19.1	Excellent	0.4	Fair
Feathers mix	60.0	98.9	54.5	Excellent	0.4	Fair
Candida	88.0	100.0	∞	Excellent	0.12	Good
Asperigillus F	54.6	100.0	∞	Excellent	0.9	Poor
Alternaria A	66.7	100.0	∞	Excellent	0.3	Fair
Penicilluim N	82.3	96.7	24.9	Excellent	0.18	Good
Cladosporium	91.7	100.0	∞	Excellent	0.11	Good
Fusarium	75.0	100.0	∞	Excellent	0.3	Fair
Chicken	50.0	100.0	∞	Excellent	0.5	Poor
Fishes Mix	58.3	93.9	52.2	Excellent	0.4	Fair
Shrimps	88.9	92.5	11.9	Excellent	0.12	Good
Corn	75.0	95.2	15.6	Excellent	0.3	Fair
Nut Mix	00.0	100.0	0.0	Excellent	1.0	Poor
Sesame	63.2	97.7	27.5	Excellent	0.4	Fair
Peanut	81.8	97.9	38.9	Excellent	0.19	Fair
Soya	88.2	98.9	7.9	Good	0.12	Poor
Egg whole	76.9	94.7	14.5	Excellent	0.24	Fair
Cow milk	83.3	100.0	∞	Excellent	0.16	Good
Cocoa	00.0	99.1	0.0	Poor	1.0	Poor
Banana	75.0	98.9	68.2	Excellent	0.25	Fair

LR –ve: Excellent < 0.1, Good 0.1-0.2, Fair 0.2-0.5, Poor ≥0.5.
LR +ve: Excellent ≥ 10, Good 5-10, Fair 2-5, Poor < 2.

Table (9) shows sensitivity and specificity of Saudi allergens compared to Omega allergens in Riyadh. Cockroach A, palm tree, goat epithelium, candida, penicillium N and coca allergens recorded the highest percentage of sensitivity (100%) while fish mix and nut mix allergens recorded the highest percentage of specificity (100%). Excellent specificity of Saudi allergens was recorded for 34 allergens including mites DP, mites DF, house dust, cockroach A, cockroach B, palm tree, pigweed, plantain, prosopis, mugwort, rye grass, timothy, bermoda, chenopodium , cat epithelium, horse hair, goat epithelium, sheep wool, candida, aspergllius F, alternaria A, penicillium N, cladosporium, fusarium, chicken, fish mix, corn, nut mix, sesame, peanut, soya, egg whole, cow milk and coca, while excellent sensitivity was recorded for 18 allergens including mite DP, mite DF, house dust, cockroach A, palm tree, prosopis, mugwort, rye grass, timothy, chenopodium, cat epithelium, goat epithelium, Candida, penicillium N, fishes mix, shrimps, nut mix and coca. Therefore, there are 17 allergens which recorded both excellent sensitivity and specificity.

Table 9: Validity of Saudi allergens compared to the Canadian Omega allergens in Al-Riyadh

Allergen	Sensitivity	Specificity	LR + ve	Clinical decision	LR - ve	Clinical Decision
Mites DP	94.6	92.9	13.3	Excellent	0.06	Excellent
Mites DF	96.0	91.5	11.3	Excellent	0.04	Excellent
House dust	92.6	94.3	16.3	Excellent	0.08	Excellent
Cockroach A	100.0	92.9	14.1	Excellent	0.0	Excellent
Cockroach B	86.8	96.6	25.5	Excellent	0.14	Good
Palm tree	100.0	95.8	23.8	Excellent	0.0	Excellent
Pigweed	78.3	97.3	29.0	Excellent	0.22	Fair
Plantain	88.2	98.4	55.1	Excellent	0.12	Good
Prosopis	91.7	95.1	18.7	Excellent	0.09	Excellent
Mugwort	94.7	94.9	18.6	Excellent	0.06	Excellent
Rye grass	92.1	98.2	61.4	Excellent	0.08	Excellent
Timothy	96.3	92.9	13.6	Excellent	0.04	Excellent
Bermoda	89.3	95.7	20.8	Excellent	0.11	Good
Chenopodium	92.6	91.4	10.8	Excellent	0.08	Excellent
Salsola kali	42.0	00.0	0.42	Poor	0.0	Poor
Cat epithelium	91.7	98.0	45.9	Excellent	0.08	Excellent
Dog epithelium	87.5	88.9	7.9	Good	0.14	Good
Horse hair	85.7	97.8	30.6	Excellent	0.15	Good
Goat epithelium	100.0	98.9	90.9	Excellent	0.0	Excellent
Sheep wool	85.7	92.8	11.9	Excellent	0.15	Good
Feathers mix	77.8	92.1	9.8	Good	0.24	Fair
Candida	100.0	97.3	37.0	Excellent	0.0	Excellent
Asperigillus F	75.0	96.6	22.1	Excellent	0.26	Fair
Alternaria A	80.0	96.6	32.5	Excellent	0.21	Fair
Penicillium N	100.0	97.9	47.6	Excellent	0.0	Excellent
Cladosporium	66.7	97.6	27.8	Excellent	0.34	Fair
Fusarium	87.5	96.7	26.5	Excellent	0.13	Good
Chicken	89.5	94.9	17.6	Excellent	0.11	Good
Fishes Mix	92.9	100.0	∞	Excellent	0.07	Excellent
Shrimps	91.3	90.6	9.7	Good	0.09	Excellent
Corn	44.4	97.7	19.3	Excellent	0.6	Poor
Nut Mix	00.0	100.0	0.00	Excellent	0.0	Excellent
Sesame	98.8	98.8	51.3	Excellent	0.39	Fair
Peanut	72.2	93.7	11.5	Excellent	0.3	Fair
Soya	70.0	97.7	30.4	Excellent	0.31	Fair
Egg whole	90.0	95.4	19.6	Excellent	0.11	Good
Cow milk	85.7	92.2	10.9	Excellent	0.16	Fair
Cocoa	100.0	94.6	18.5	Excellent	0.0	Excellent
Banana	69.2	89.3	6.5	Good	0.35	Fair

LR –ve: Excellent < 0.1, Good 0.1-0.2, Fair 0.2-0.5, Poor ≥0.5.
LR +ve: Excellent ≥ 10, Good 5-10, Fair 2-5, Poor < 2.

Table (10) shows sensitivity and specificity of Saudi allergens compared to Omega allergens in Khamis Mushait. HDM, aspergilius F, alternaria ,egg whole, cow milk, banana allergens recorded the highest percentage of sensitivity (100%) while mites DF, palm tree, prosopis, salsola kali, cat epithelium, dog epithelium, sheepwool, alternaria A, penicillium, cladosporium, shrimps, nut mix, cow milk and coca allergens recorded the highest percentage of specificity (100%). Excellent specicicity of Saudi allergens was recorded for 32 allergens including mite DF, cockroach A, cockroach B, palm tree, pigweed plantain, rye grass, timothy, bermoda, chenopodium, salsola kali, cat epithelium, dog epithelium, horse hair, goat epithelium, feathers mix, Candida, aspergilliusF, alternariaA, penicillium N, cladosporium, fusarium, chicken, fish mix, shrimps, corn, nut mix, sesame, soya, egg whole, cow milk and bananas while excellent sensitivity was recorded for 14 allergens including HDM, cockroach A, prosopis, timothy, salsola kali, cat epithelium, Candida, Aspergillus F, Alternaria A, Penicilluim N, egg whole, cow milk, coca and banana. Therefore, there are 11 allergens which recorded both excellent sensitivity and specificity.

Table 10: Validity of Saudi allergens compared to the Canadian Omega allergens in Khamis Mushait.

Allergen	Sensitivity	Specificity	LR + ve	Clinical decision	LR - ve	Clinical decision
Mites DP	87.8	91.2	9.9	Good	0.13	Good
Mites DF	80.9	100.0	∞	Excellent	0.1	Good
House dust	100.0	94.1	5.6	Good	0.0	Excellent
Cockroach A	91.7	92.3	15.5	Excellent	0.09	Excellent
Cockroach B	84.4	94.1	∞	Excellent	0.1	Good
Palm tree	85.3	100.0	65.6	Excellent	0.15	Good
Pigweed	87.5	97.6	29.2	Excellent	0.13	Good
Plantain	80.0	97.0	∞	Excellent	0.2	Good
Prosopis	91.2	100.0	0.36	Fair	0.09	Excellent
Mugwort	84.2	97.5	0.1	Fair	0.16	Good
Rye grass	81.8	98.2	23.5	Excellent	0.18	Good
Timothy	92.9	96.9	58.0	Excellent	0.07	Excellent
Bermoda	86.4	98.4	22.7	Excellent	0.15	Good
Chenopod	86.2	96.2	∞	Excellent	0.14	Good
Salsola kali	97.6	100.0	∞	Excellent	0.02	Excellent
Cat epith	95.8	96.1	24.6	Excellent	0.04	Excellent
Dog epith	80.0	100.0	∞	Excellent	0.20	Fair
Horse hair	83.3	98.6	59.5	Excellent	0.17	Good
Goat epith	73.3	96.9	14.7	Excellent	0.28	Fair
Sheep wool	76.9	100.0	9.5	Good	0.25	Fair
Feathers mix	90.0	100.0	29.0	Excellent	0.1	Good
Candida	94.7	98.5	∞	Excellent	0.05	Excellent
Asperigillus F	100.0	98.4	∞	Excellent	0.0	Excellent
Alternaria A	100.0	100.0	66.7	Excellent	0.0	Excellent
Penicilluim N	92.3	100.0	57.7	Excellent	0.07	Excellent
Cladosporium	72.7	100.0	∞	Excellent	0.27	Fair
Fusarium	75.0	93.2	∞	Excellent	0.25	Fair
Chicken	75.0	92.9	∞	Excellent	0.25	Fair
Fishes Mix	75.0	98.3	11.0	Excellent	0.26	Fair
Shrimps	89.5	100.0	12.6	Excellent	0.11	Good
Corn	87.5	95.2	51.5	Excellent	0.13	Good
Nut Mix	83.3	100.0	∞	Excellent	0.18	Good
Sesame	83.3	95.2	17.4	Excellent	0.18	Good
Peanut	83.3	89.6	8.0	Good	0.19	Good
Soya	76.9	98.4	48.1	Excellent	0.23	Fair
Egg whole	100.0	98.5	66.7	Excellent	0.0	Excellent
Cow milk	100.0	100.0	∞	Excellent	0.0	Excellent
Cocoa	0.0	100.0	0.0	Fair	0.0	Excellent
Banana	100.0	98.5	66.7	Excellent	0.0	Excellent

LR –ve: Excellent < 0.1, Good 0.1-0.2, Fair 0.2-0.5, Poor ≥0.5.
LR +ve: Excellent ≥ 10, Good 5-10, Fair 2-5, Poor < 2.

DISCUSSION

Allergic diseases are considered a great problem all over the world and also a special problem in Saudi Arabia. Environmental pollution by allergens may be responsible for rising asthma prevalence in KSA. Saudi Arabia has variable geography with consequent variations in the content of allergens in different geographical regions. This study was conducted to identify the most common allergens in KSA. The study included 494 patients complaining of allergic diseases and selected out of 2000 subjects complaining of allergic manifestations in five large cities in KSA; Al-Khobar, Jeddah, Al-Ehsaa, Riyadh, and Khamis Moshait.

The study revealed that the prevalence of allergies was in Al-khobar (28%), in Jeddah (25.75%), in Al-Ehsaa (26.75%), in Riyadh (24.25%), and in Khamis

Mushait (18.75%). The mean of prevalence was 24.7% which is comparable to the global prevalence of asthma. Statistics received to the World Allergy Organization (WAO) from 33 countries, representing a population of 1.39 billion people, stated that 22% may suffer from some form of allergic disease.[10] The results of this study greatly exceeded the prevalence of allergic diseases in KSA at 1989 which was studied by Al Nahdi and Ibrahim[1], and was about 9.3%.[11] On the other hand, it approximates the results of the study conducted by Al-Ferayh and his co-workers, who found that asthma prevalence among school children ranged between 4%-23% in different areas from all over the KSA.[12] They had another study at 2004 in which they observed an increased prevalence of asthma in recent years in KSA school children.[13] They explained that by the repeated exposure to both outdoor and indoor allergens as the change in the environment directly or indirectly could be responsible for the observed increase in the prevalence of asthma. They reported also that genetic factors could contribute to the increasing prevalence of asthma over a relatively short period.

Using the locally prepared Saudi allergens, the most common allergens in KSA differed from one area to the other. In Al-Khobar, they were Mites DF (49.1%), House dust mite (42.9%), and Mites DP (39.3%). In Jeddah, they were Mites DF (51.5%), Mite DP (48.5%), and house dust mite (39.8%). In Al-Ehsaa, they were Salsola kali (60.7%), Mites DP (52.3%), and Mites DF (48.6%). In Riyadh, they were Mites DP (56.7%), Mites DF (53.6%), Cat epithelium (46.4%). In Khamis Mushait, they were Salsola kali (54.7%), Mites DP (48%), and Prosopis (42.7%). This difference in the common allergens in different areas may be due to the geographic nature and the nature of the indoor and outdoor environments. This agrees with a previous study conducted by Hasanin and his co-workers[14], which included asthmatic children in four different areas in KSA; Jeddah, Riyadh, Hail and Gizan. They found different allergen profiles in different KSA areas and attributed these results to the influence of climatic and environmental factors and their impact on sensitization.[14]

Al-Ferayh and his co-workers, reported that a large number of plants have been introduced to the Kingdom in the recent years. Fungal spores and airborne pollens of grasses, weeds, and trees have been detected. Indoor allergens have also been shown to be associated with asthma among school children. Their study revealed increased exposure to environmental factors such as tobacco smoke and indoor animals in Saudi houses. It seemed that Saudi people life style contributed to increased prevalence of allergy. Saudi society has experienced a change in life style from rural to urban in the recent past , and this urbanization may have an association with allergy attributable to general change in domestic environment.[15]

Bjorksten reported that the concepts of lifestyle and environment should be expanded to include, for example, dietary changes, microbial environment, extensive traveling, as all these risk factors taken together can only explain a small proportion of geographic differences in increasing prevalence of allergy[16]. Due to these geographic differences, Bernstein and his colleagues, recommended that the allergist should be prepared to evaluate patient exposure to allergic and non allergic triggers and understand how outdoor air pollution is affecting indoor environments.[17]

On comparing the mean diameter values of skin test of Saudi allergens in relation to Omega allergens in the five studied areas, we found that most mean diameters of SPT in Saudi allergens were nearly corresponding to the mean diameters of Omega allergens and only small differences were recorded. It was also observed that, in spite of the presence of significant P values between some (S) allergens and (O) allergens in some areas, no significant P value were recorded for the same allergens in the other areas. This variation may be explained by the great differences in geographic areas, environmental factors and variation of types of allergens to which the patients were sensitized.

Mason, reported that the crucial point in allergen extraction is to find procedure that yields optimal allergenic activity. This procedure should elicit an extract which is representative for the raw material with respect to its allergen composition. It was observed that four factors can greatly affect extraction processes; time, temperature, extraction fluid and mechanical processing as they can interfere with each other. The extraction period must be enough as the chosen extraction times will be a compromise between a possible proteolytic degradation and maximum yield of allergenic activity.[18]

A recent study was conducted by Eiman and her co-workers, they compared Saudi allergens to Canadian Omega allergens, they observed that there were significant differences between the validity of the two types of allergens. The Canadian extracts were significantly more valid than Saudi extracts. They revealed also that there was agreement between the two types of extracts in 61.8% of allergens while the Saudi extracts were better at 17.2% of allergens and the Canadian extracts were better in 21% of allergens. They attributed this variation to the purity of the allergen and different species of allergens.[19]

In conclusion, this work demonstrated that allergy is prevalent in KSA. The most common environmental allergens were house dust mites with its two types DP and DF, pollens as salsola kali, prosopis and palm tree, cockroach and cat epithelium. The difference of common allergens in each locality of the five studied areas may be attributed to different environmental circumstances and to variation in geography, climate and culture. For example, highly humid areas are good

media for growth of HDM and cockroach while agricultural areas provide their atmosphere with pollens of trees and grasses.

Although the results of this study revealed that the Saudi allergens validity ranged from good to poor compared to Omega allergens, we have prepared valuable and suitable allergen extracts from our related allergens which helped in diagnosis of allergic subjects by skin test and which can be used in the future in the treatment of allergic subjects by the desensitization procedure. It is recommended that for proper use of the extracted allergens in skin prick test, there are many factors that have to be adjusted as the method of extraction, clarification, purification, and concentration. Reevaluation of methods and tools of allergy diagnosis in KSA keeping in consideration the common local allergens in the kingdom together with training of its physicians and doctors are also recommended.

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