CONTEMPORARY CHALLENGES OF PHARMACEUTICAL COMPOUNDING IN SOUTHERN NIGERIA: RESULTS OF SURVEY

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In the past decade the pharmacy practice worldwide has witness a trend shift from product-orientation to patient-orientation. This and other reasons encouraged the Nigerian government and its institutions to systematically de-emphasized through its budget, funding for the development of compounding unit.

Aim: The aim of given article was to examine the challenges facing compounding pharmacists in hospital pharmacies, cost estimating of extemporaneous preparations and searching of solutions.

Methods: A closed and open-ended format questionnaire was distributed to 50 compounding pharmacists in Rivers State of Nigeria. The questionnaire comprised of a cover letter and 10 items which cut across personnel training, staffing, premise and equipment, logistics, cost of compounding, national reference standards on compounding, in-pharmacy control.

Results: From the survey results, challenges of compounding pharmacies in southern Nigeria such as inadequate manpower, absence of electronic documentation, facilities and funding; lack of national formulary on extemporaneous formulations and locally conducted stability tests were revealed. Cost of extemporaneous preparations ranged from 1–15 US dollars.

Conclusions: Development and implementation of easily accessible national formulary on extemporaneous formulations and their stability study, development of standard operating procedures for all activities in the pharmacy and staff training on recent technologies in compounding preparations are recommended

Keywords: compounded preparations, hospital pharmacy, questionnaire, standard operating procedure, national formulary, stability

1. Introduction
In the past decade the pharmacy practice worldwide has experienced a shift from product-orientation to patient-orientation [1–3]. Compounding is the preparation (mixing, altering, assembling), under the supervision of a licenced pharmacist, of a medication that is not commercially available in the concentration or form needed for a specific patient pursuant to a prescription [4]. Products of compounding are called compounded preparations, extemporaneous formulations and compounded medications. The British pharmacopoeia refers to them as unlicensed medicines [5].
3. Analysis of recent studies and publications in which a solution of the problem and which draws on the author
Organizational and economic problems of pharmaceutical compounding and its preservation for a long time are discussed by the pharmaceutical community [6–9]. Usually these problems are due to insufficient development of the pharmaceutical legislation in the absence of adequate funding.

4. Allocation of unsolved parts of the general problem, which is dedicated to the article
Study of problems of pharmaceutical compounding and dynamics of main economic indicators are relevant today. These include compliance to good compounding and pharmacy practices such as standard operating procedures, accessible harmonized national formulated and updates on local stability tests for extemporaneous formulations, quality control, and cost of extemporaneous preparations, logistics and adequate facilities.

5. Formulation of goals (tasks) of article
The aim of this study is to examine challenges facing compounding pharmacists in hospital pharmacies in southern Nigeria, cost of extemporaneous preparations and proffer solutions.

6. Statement of the basic material of the study (methods and objects) with the justification of the results
A closed and open-ended format questionnaire was distributed to 50 compounding pharmacists. The survey was conducted in River State (southern Nigeria) within the period of October – December 2015. The questionnaire comprised of a cover letter and 10 items which cut across personnel training, staffing, premise and equipment, logistics, cost of compounding, national reference standards on compounding, in-pharmacy control. The statement was considered accepted if it is affirmed by 50% of the respondents. Data from questionnaire were analysed into Microsoft Excel 2010 and summarized below.

Out of the 50 distributed questionnaires, a total of 48 were returned, representing a 96% response rate of the sample size. Mean scores were determined for each item and the summarized data presented below.

<table>
<thead>
<tr>
<th>#</th>
<th>Questions</th>
<th>Scales (responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you believe a biennial seminar/workshop for compounding pharmacists on recent scientific research is necessary?</td>
<td>Yes 100 % No 0%</td>
</tr>
<tr>
<td>2</td>
<td>Type of API used during compounding</td>
<td>Pure 7.1 % API, as part of commercial drug (tablet, capsule, injection etc) 92.9 %</td>
</tr>
<tr>
<td>3</td>
<td>Vehicles/bases used</td>
<td>Import- ed(ORA-Plus, ORA- Sweet etc) 47.6 % Locally available (Vit C, Vit BCo etc) 38.1 % Both 11.9 % Abstained from answering question 2.4 %</td>
</tr>
<tr>
<td>4</td>
<td>What determines the cost of a Rx</td>
<td>API 16.7 % Base/Vehicle 23.8 % Both 52.4 % Abstained from answering question 7.1 %</td>
</tr>
<tr>
<td>5</td>
<td>Possible high cost for a compounded preparation ($)</td>
<td>1 USD 2.4 % 1–3 USD 16.7 % 3–5 USD 61.9 % 5–15 USD 4.8 % &gt;15 USD 7.1 % Abstained from answering question 7.1 %</td>
</tr>
<tr>
<td>6</td>
<td>Possible low cost for a compounded preparation ($)</td>
<td>&lt;0.5 USD 9.6 % &lt;1 USD 14.3 % 1–3 USD 61.9 % 3–5 USD 7.1 % Abstained from answering question 7.1 %</td>
</tr>
<tr>
<td>7</td>
<td>Awareness/existence of Nig. Ref. standards on compounding or quality control</td>
<td>Aware 2.4 % Not aware 95.2 % Abstained from answering question 2.4 %</td>
</tr>
<tr>
<td>8</td>
<td>Existence/awareness of stability tests conducted in(for the country)</td>
<td>Aware 35.7 % Not aware 61.9 % Abstained from answering question 2.4 %</td>
</tr>
<tr>
<td>9</td>
<td>Adequacy of quality control lab</td>
<td>Adequate 21.4 % Inadequate 76.2 % Abstained from answering question 2.4 %</td>
</tr>
<tr>
<td>10</td>
<td>Who should equip the Q.C. Lab?</td>
<td>Hospital 33.3 % Government 42.9 % Private firms – H+G 11.9 % All stakeholders 11.9 %</td>
</tr>
</tbody>
</table>
Cost: Compounding in Nigeria is done mainly in government-owned hospital pharmacies, where the cost of extemporaneous preparations is highly subsidized. Whilst 61.9\% of respondents pegged the possible high cost of a compounded prescription to be in the range of 3–5 USD, extemporaneous formulations in the pharmacy could go for as high as 15 USD. 61.9\% of respondents pegged the lowest possible cost of a compounded prescription to be in the range of 3-5 USD. 52.4\% of respondents agree that the cost of both APIs and vehicles/bases determine the final cost of the extemporaneous medication. The cost of APIs is subsidized if they are included in the National health insurance scheme (NHIS) drug list [10]. A fee (maybe fixed) for compounding service as proposed and obtainable in some countries should be stipulated to enable the pharmacist place the patient as the primary focus and the cost of the product as a secondary in priority [11].

Personnel and training: 100.0\% of the respondents approved a biennial seminar/workshop on recent scientific development on compounding; the curriculum should include the course of quality assurance of compounding preparations [12].

Staffing: The ratio of compounding pharmacists to population is very low [13]. This poses a threat of wear-out, prescription errors and less time devoted to patient counselling on medications. Compounding is done mainly by pharmacists.

Documentation: Thanks to routine preparation of monthly reports the practice of documentation has being strong. However, only 30.9\% of respondents had switched to electronic (computer-based) documentation of compounded formulations. Their reasons bothered on time constraint as a result of understaffing.

Logistics: availability of required APIs and excipients (vehicle/bases) is an important aspect of compounding. Although use of pure substances is preferable, 92.9\% use commercial drugs (tablet, capsules etc.) as APIs for compounding. Vehicles/bases utilised include ORA-Plus, ORA-Sweet, cherry syrup, simple syrup USP. A staggering 50\% of the respondents said there was difficulty accessing required ingredients for compounding. The problem of logistics is being tackled by both the Nigerian government and the Pharmaceutical Society of Nigeria through a proposed Mega drug distribution System [14, 15].

Premises and equipment: Until recently, the pharmacy unit as a whole was planned and designed by doctors. Pharmacists made no input. As a result compounding units are poorly planned. Head of Hospitals and clinics (doctors) are forced to make readjustments of the pharmacy premises to meet a required specification recommended by the NHIS [16], when they apply for accreditation to join the scheme. Since compounding units is not a compulsory requirement for registration of hospital pharmacies with the scheme, pharmacists are forced to make a strong case for its inclusion. Compounding unit specifications should be stipulated and included in the requirements for setup of a hospital.

Quality Control: 76.2\% complain of inadequately equipped compounding units. 33.3\% and 42.9\% ascribe responsibility of an adequately equipped compounding unit on the hospital itself and government respectively. 11.9\% place the responsibility on both while the same percentage believes all (including private firms) stakeholders share the responsibility. All respondents (100\%) acceded to the need for development and implementation of standard operating procedures (SOP) for all activities in the pharmacy, including all stages of compounding, routine cleaning procedures, compounding equipment and environmental conditions under which products are prepared to enhance quality assurance [17].

In-pharmacy control: 100\% of the participants (respondents) confirmed in-pharmacy control. Prescriptions are vetted before compounding. Calculations and technology of production are checked by the supervising pharmacist before compounding. The compounded formulation is checked by another pharmacist before dispensing. Stocks are checked monthly. Erring pharmacists are retrained on the job. Raw materials are examined on reception, before storage and before use. Inspection of compounding by regulatory bodies is less frequent.

Reference standard: the reference standards used within the pharmacy include the British Pharmaceutical Codex, British Pharmacopoeia, United States Pharmacopoeia, the American Society of Health System Pharmacists Drug Information, Information from the International Journal of Pharmaceutical Compounding and other available sources that provide information on stability studies or recent updates relating to drug compounding. From the survey, 95.2\% of respondents are not aware of the existence of a national reference standard. Neither is 61.9\% aware of any stability tests being conducted in/for the country (Nigeria). A template for national formulary for compounded drugs is therefore proposed in Fig. 1, similar to existing/proposed formats in other countries [18–20].

This should be in a database form, containing readily accessible formulary to pharmacists nationwide. The formulary should include formula magistrals and medicines prepared by a hospital or community pharmacy in accordance with instructions in a compendium, pharmacopoeia or a formulary and dispensed by a pharmacy to patients [21, 22].

It should be subject to regular updates and a channel (or forum) [23] be created for inputs on new formulas/recipe. The advantages include access to locally usable information, increased quality assurance, inputs from academic and practicing pharmacists, and a harmonised national formulary of suitable formulations [24]. Stability tests should be made using products readily available in the country. Since generics of the same drug may produce different stability results due to the use of different excipients, it becomes necessary that the specific company producing the generic be mentioned.
**Fig. 1. Proposed format for compounding preparation formulary**

<table>
<thead>
<tr>
<th>Name/Strength/Dosage form: Propranolol 1 mg/ml Suspension</th>
<th>Route of Administration: Oral</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Strength</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propranolol Tablets</td>
<td>40 mg</td>
<td>6 tablets</td>
</tr>
<tr>
<td>Distilled water(wetting agent)</td>
<td></td>
<td>4.8 ml</td>
</tr>
<tr>
<td>Citric acid Solution</td>
<td>25 %</td>
<td>1 ml</td>
</tr>
<tr>
<td>Simple Syrup</td>
<td>qs</td>
<td>240 ml</td>
</tr>
</tbody>
</table>

**Procedure:**
1. Crush tablets in a mortar to a fine powder.
2. Levigate the powder with distilled water until a smooth paste.
3. Add a small amount of simple syrup to form a smooth paste. Add more syrup until a liquid is formed and transfer the contents into a graduated cylinder. Use additional simple syrup to rinse the remaining drug from the mortar.
4. Add citric acid to the suspension in the graduate. Mix well.
5. QS to final volume with simple syrup.
6. Transfer the suspension into amber bottle
7. Shake well and label

**Storage requirements:** Refrigerate. Keep in amber bottle. Protect from light.

**Stability:** 45 days

**Reference:**
1. Pharmacy Compounding Manual May 2011, Alberta Health Services Calgary and Area , p. 179

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**7. Conclusion**

The survey reveals challenges of compounding pharmacists in southern Nigeria such as inadequate manpower, electronic documentation, facilities and funding, access to a comprehensive national formulary on extemporaneous formulations and locally conducted stability tests.

Full electronic documentation, increased government funding for quality assurance conditions, logistics, adequate equipment of the compounding and quality control units, recruitment of more pharmacists is advocated.

An easily accessible national formulary on extemporaneous formulations and their stability study, development and implementation of SOP for all activities in the pharmacy and staff training on recent technologies in compounding preparation are recommended.

**References**
References


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Дата надходження рукопису 24.02.2016
DEVELOPMENT OF METHODS FOR DETERMINATION OF PHENOLIC ACIDS AND FLAVONOIDS IN CAPSULES CONTAINING CORYLUS AVELLANA L. DRY EXTRACT

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The questions of standardization and quality control of both herbs and herbal remedies remain relevant, because it is well-known that product quality standards are essential, whether consumer using herbs or drugs. The necessity of the standardization methods development for the initial herbal material and capsule dosage form for the further quality control under manufacturing conditions remains relevant.

**Aim.** The aim of our research was to develop simple, specific, accurate and reproducible methods for identification of flavonoids and phenolic acids in capsule dosage form containing Corylus avellana L. dry extract.

**Methods.** The samples of gelatine capsules containing Corylus avellana L. dry extract for oral administration were analyzed. The analysis was carried out using Camag HPTLC system. The absorption spectroscopy determination of the sum of flavonoids was carried out using THERMO Scientific Evolution 60S Spectroscope in wavelength range of 300–600 nm.

**Results.** As a result of HPTLC research rutine and quercitrine have been identified in capsule dosage form containing Corylus avellana L. dry extract. Among phenolic acids, neochlorogenic and chlorogenic acids have been identified. Under the given conditions, the spectrum of the test solution had a maximum absorption at wavelength 406 nm. The analysis of flavonoids total content in gelatine capsules containing Corylus avellana L. dry extract calculated as rutine has shown the content of 1,7 %.

**Conclusion.** Effective HPTLC and absorption spectroscopy methods for determination of flavonoids and phenolic acids in capsule dosage form containing Corylus avellana L. dry extract have been developed. It has been found that described methods are promising enough for standardization of capsules with Corylus avellana L. dry extract and may be suggested for the quality control of the dosage form under manufacturing conditions.

**Keywords:** capsules, Corylus avellana L., extract, HPTLC, absorption spectroscopy, phenolic acids, flavonoids