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Active Ingredient Content Assessment of Five Antalgics Sold in Pharmacies and Street Markets in Niamey

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ABSTRACT :

Analgesics constitute a major category of medicines used in Niger, particularly in Niamey. However, the widespread circulation of counterfeit and substandard pharmaceutical products in informal street markets represents a serious public health concern. This study aimed to quantify the active ingredient content of five commonly used analgesics in Niamey paracetamol, aspirin, ibuprofen, diclofenac, and tramadol. Samples of each medicine were randomly collected from both licensed pharmacies and informal street vendors. Quantitative analyses were carried out using UV–Visible spectrophotometry, and the obtained values were compared with the standards prescribed by the International Pharmacopoeia. Data processing and statistical interpretation were performed using Origin Graph 2025 software. The analyses revealed significant deviations between the measured active ingredient contents and pharmacopoeial specifications (discrepancies exceeding ±10% of the reference standard) across products from both the formal and informal sectors. The main types of non-compliance identified were overdosing (22.22%) and underdosing (37.04%). These findings underscore the potential health risks associated with the use of substandard or falsified medicines. The circulation of poor-quality pharmaceutical products constitutes a major threat to public health and highlights the urgent need for strengthened quality control mechanisms and improved regulatory oversight of the pharmaceutical supply chain in Niger. The aim of this study is to evaluate and compare the compliance with quality standars (particulary the content of active ingredient) of five commoly consumed antalgicsn, from official channels (pharmacies) and street markets in Niamey, in order to provide factual data on the potential risks to public health.

Keywords: antalgics, active ingredient, content, spectrophotometry, Niamey.

1. INTRODUCTION

Analgesics are among the most widely used medicines for the management of pain worldwide. However, the quality of pharmaceutical products available on the market particularly in low- and middle-income countries remains a major concern [1]. The circulation of counterfeit and substandard medicines represents a critical public health threat, with consequences ranging from therapeutic failure to toxicity, the emergence of antimicrobial resistance, and even mortality [2]. According to the World Health Organization, approximately one in ten medical products in low- and middle-income countries is estimated to be substandard or falsified [3].

In Niger, and especially in Niamey, the consumption of analgesics has increased considerably due to their widespread availability, low cost, and frequent use in the management of pain and fever. Nevertheless, the proliferation of counterfeit and poor-quality medicines in informal markets continues to pose a major challenge to public health and patient safety [4].

Analgesics such as paracetamol, aspirin, ibuprofen, diclofenac, and tramadol are particularly relevant in West Africa, as they are among the most frequently consumed pharmaceutical products in the region [5]. Ensuring their quality is therefore essential to prevent therapeutic inefficacy and avoid potential toxicities associated with under- or overdosing.

The objective of this study is to evaluate the active ingredient content of five commonly used analgesics paracetamol, aspirin, ibuprofen, diclofenac, and tramadol collected in Niamey from both licensed pharmacies and informal street markets, in order to identify potential discrepancies in product quality between the two distribution channels.

2. MATERIALS AND METHODS

2.1. Research area

The study was conducted in Niamey, the capital city of Niger, where pharmaceutical products are distributed through both formal channels such as licensed and accredited pharmacies and informal outlets, including street markets and unregulated vendors. Niamey represents a particularly relevant setting for this investigation due to its high population density, its central role in the country's pharmaceutical supply chain, and the documented coexistence of regulated and unregulated points of sale. This context provides an appropriate framework for assessing potential disparities in the quality of analgesics available to the population.

2.2. Sampling

A total of 30 samples were collected for this study (five analgesics × six samples each), comprising 15 samples obtained from licensed pharmacies and 15 from informal street markets. To minimise selection bias, all samples were collected randomly from three accredited pharmacies and three street vendors operating in different districts of Niamey. Each sample was assigned a unique identification code to ensure traceability and to maintain blinding during laboratory analysis.

All collected analgesics were analysed according to the assay procedures recommended by the European Pharmacopoeia [3]. Data analysis, graphical processing, and visual representation were performed using Origin Graph 2025 and Visio 4.0 Professional software.

2.3. Spectrophotometric analysis

Many pharmaceutical compounds exhibit absorption in the ultraviolet (UV) and visible regions of the electromagnetic spectrum. UV–Visible spectrophotometry is based on the interaction of light with matter, and the resulting absorption spectra provide information on both the identity and concentration of analytes. In this study, the analytical method consisted of comparing the UV–Visible spectra of each sample with those of an authenticated reference standard, in accordance with WHO guidelines [1].

Absorbance spectra (OD = f(λ)) were recorded in various media including aqueous, acidic, basic, methanolic, and ethanolic solutions at concentrations compatible with the Beer–Lambert law. The superposition of sample and reference spectra was used to confirm the identity of the active pharmaceutical ingredient. Quantification of the active ingredient was performed using the following ratio:

$$\mathbf{T} = \frac{OD(sample)}{OD(reference)}$$

where *T* represents the relative content of the active ingredient, and *OD* corresponds to the optical density (absorbance).

All measurements were carried out using a THERMO SCIENTIFIC EVOLUTION 300® UV–Vis spectrophotometer, a double-beam instrument equipped with variable spectral slits (0.1–5 nm), rotating mirrors, and photomultiplier detectors for enhanced sensitivity and precision.

According to the European Pharmacopoeia (2019), a product is considered compliant when the measured active ingredient content is not less than 90% and not more than 110% of the labelled amount [3].

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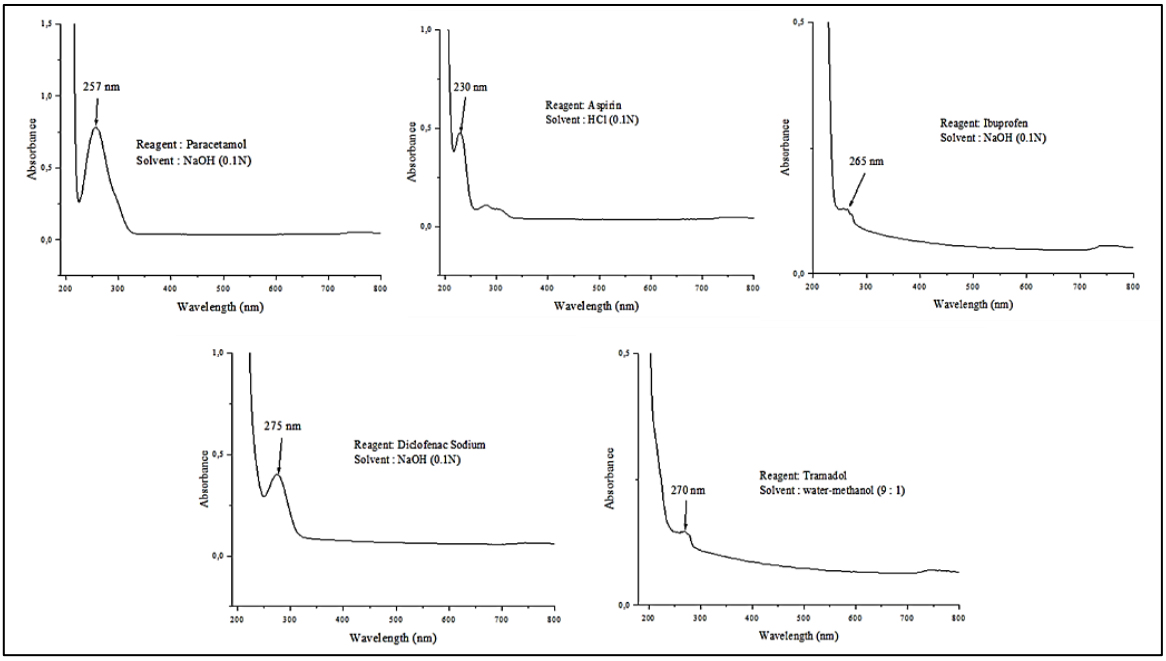

Fig. 1 : Wavelength of measured analgesic agents

Table I : **Dosed analgesic solutions**

Molecules	Wavelength	Solution	Dilution
Paracetamol	257 nm	NaOH 0.1 N	10 µg/mL.
Aspirin	230nm	HCl 0.1 N	10 µg/mL
Ibuprofen	265nm	NaOH 0.1 N	10 µg/mL
Diclofenac sodium	275nm	NaOH 0.1 N	10 µg/mL
Tramadol	270nm	water-methanol (9 : 1)	10 µg/mL

3. RESULTS AND DISCUSSION

Table II : **Sample content**

	M1	M2	M3	P1	P2	P3
Paracetamol content 500mg						
T(%)	113.52	97.57	111.73	91.96	96.55	99.87
Aspirin content 500mg						
T(%)	87.55	74.26	85.23	121.94	81.43	127.63
Ibuprofen content 400mg						
T(%)	96.87	84.37	86.71	92.96	82.81	88.28
Diclofenac sodium content 50mg						
T(%)	88.52	91.02	78.55	92.76	94.26	92.01
Tramadol content 120mg						
T(%)	122.44	125.85	95.23	ND	ND	ND

T(%): Content in percentage; ND: Not Determined; M: Market; P: Pharmacy

A total of 30 samples were collected, of which 27 were analyzed. Among these, 16 samples were found to be non-compliant, corresponding to a non-conformity rate of 59.26%. Specifically, 37.04% exhibited under-dosage, while 22.22% presented over-dosage of the active pharmaceutical ingredient (API).

This non-compliance rate is considerably higher than that reported by Moussa Sidibé (2010) in Conakry (Guinea), during a quality assessment of amoxicillin- and ampicillin-based antibiotics, which identified 16.7% under-dosed and 8.3% over-dosed formulations [6].

Over-dosage of medicinal products can lead to severe adverse effects due to excessive systemic exposure. Such deviations may compromise patient safety by provoking toxic reactions, thereby exceeding the expected therapeutic window.

Conversely, under-dosage increases the risk of therapeutic failure by providing insufficient drug exposure to achieve the desired pharmacological response. Inadequate dosing not only renders treatment ineffective but may also promote the emergence of bacterial resistance, a phenomenon widely documented in pharmaceutical quality guidelines [3].

These anomalies may result from several factors, including counterfeiting, non-compliance with Good Manufacturing Practices (GMPs), inadequate transport or storage conditions, or even fraudulent practices by unauthorized street vendors.

Table III : Mean values of samples per formal and informal sector

Analgesics	Pharmacopoeia Standard	Mean contents, market (%)	Mean contents, pharmacy (%)	Conformity
Paracetamol	90 - 110%	107.6067 ± 8.7379	96.1266 ± 3.9719	Market and pharmacy in conformity
Aspirin	90 - 110%	82.3466 ± 7.0986	110.3333 ± 25.1921	Non-conform, market
Ibuprofen	90 - 110%	89.3166 ± 6.6451	88.01667 ± 5.0801	Non- conform, market and pharmacy
Diclofenac	90 - 110%	86.0300 ± 6.5973	93.01 ± 1.1456	Non-conform, market
Tramadol	90 - 110%	114.5067 ± 16.7809	-	Non-conform, market

Interpretation of results

Spectrophotometric analysis of paracetamol, aspirin, ibuprofen, diclofenac sodium and tramadol samples, collected from both licensed pharmacies and informal street markets in Niamey, enabled the quantitative assessment of their active pharmaceutical ingredient (API) content and their compliance with pharmacopoeial specifications. According to international standards, particularly those of major pharmacopoeias, an acceptable API content typically ranges from **90% to 110%** of the labelled amount. This analytical approach provided a robust basis for evaluating the quality and authenticity of the medicines circulating within the study area.

3.1. Paracetamol 500 mg

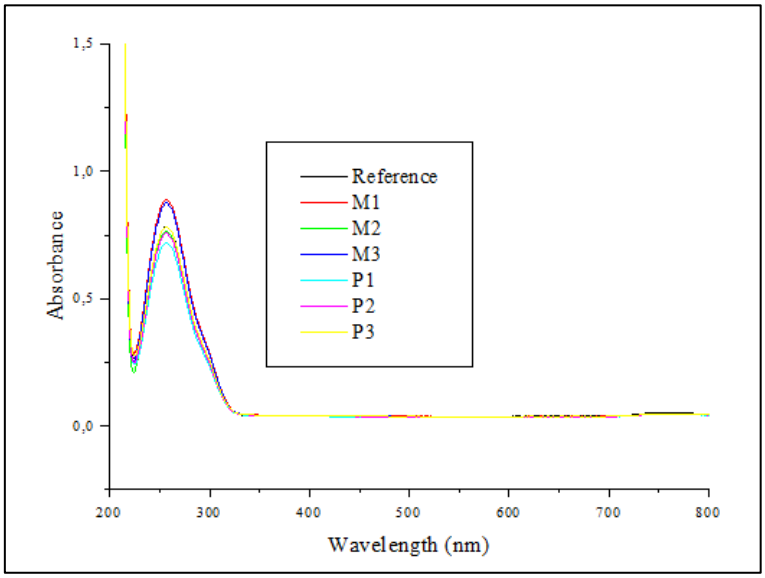

Fig. 2 : **Paracetamol spectra**

The spectrophotometric analysis of paracetamol samples revealed clear differences between products sold in pharmacies and those obtained from street markets. The mean API content for samples from pharmacies was 96.1%, whereas samples collected from informal street markets showed a higher average content of 107.6%.

The conformity rate showed a strong contrast between the two distribution channels:

- Pharmacies: 100% of samples complied with pharmacopoeial standards (90–110%).
- Street markets: Only 33% of samples complied.

Pharmacy samples exhibited good homogeneity and remained well within the acceptable quality range, reflecting controlled storage conditions and adherence to regulatory standards.

In contrast, street market samples presented substantial variability. Notably, two samples showed overdosed API contents (113.52% and 111.73%). Such overdosing may arise from inconsistent formulation practices, improper manufacturing processes, or substitution of the declared active ingredient with uncontrolled bulk powders.

Clinically, paracetamol overdosing poses a risk of hepatotoxicity, particularly if consumed repeatedly or combined with other hepatotoxic substances. The variability observed in street market samples highlights the potential dangers related to medicines circulating outside regulated supply chains.

3.2. Aspirin 500 mg

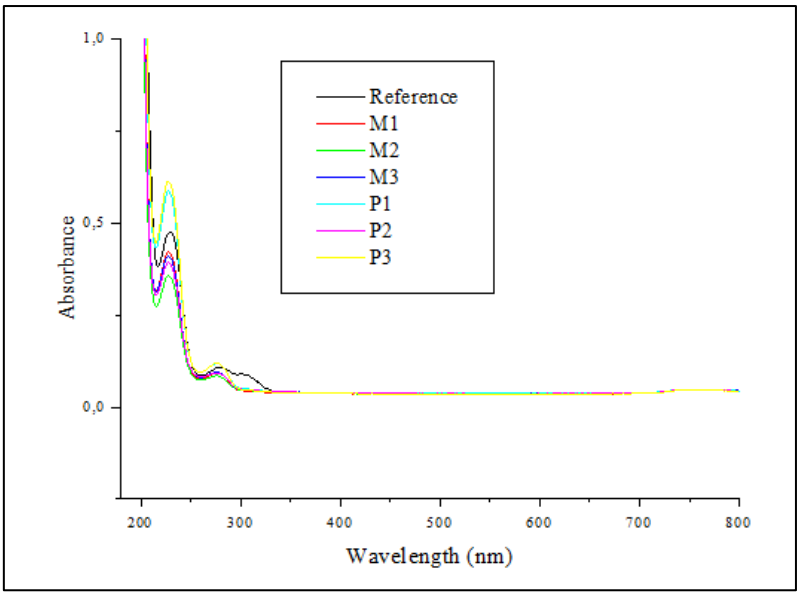

Fig. 3 : **Aspirin spectrum**

The analysis of aspirin samples revealed marked discrepancies between products sourced from pharmacies and those obtained from street markets. The mean active ingredient content of samples from informal markets was 82.3%, substantially below the pharmacopoeial specification (90–110%). In contrast, pharmacy samples showed a higher average content of 110.3%.

The compliance rates further illustrate this disparity:

- Street markets: 0% of samples were compliant.
- Pharmacies: Only 33% of samples met pharmacopoeial standards.

Street market samples exhibited pronounced under-dosage, which places patients at significant risk of therapeutic failure, particularly for conditions requiring effective antiplatelet or analgesic action. Sub-therapeutic dosing may also encourage inappropriate self-medication behaviours due to the absence of expected clinical relief.

Conversely, some pharmacy samples showed marked overdosing, with API levels reaching 121.94% and 127.63%. Such excessive concentrations increase the likelihood of serious gastrointestinal adverse effects, including gastric irritation, mucosal erosion, and upper gastrointestinal bleeding well-documented complications associated with elevated doses of acetylsalicylic acid.

These findings indicate that quality inconsistencies affect both regulated and unregulated distribution channels, underscoring the need for strengthened quality assurance measures and stricter surveillance of pharmaceutical products circulating in Niamey.

3.3. Ibuprofen 400 mg

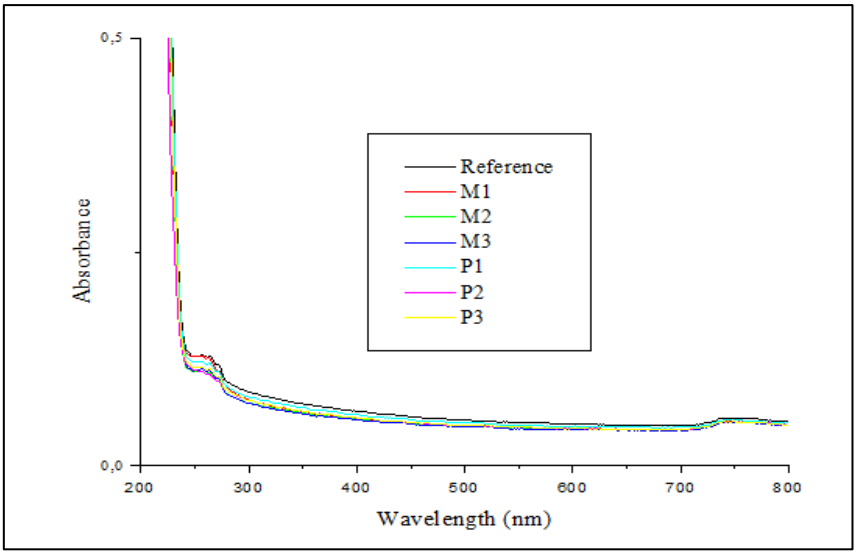

Fig. 4 : **Ibuprofen spectra**

The ibuprofen samples analysed exhibited consistently low active ingredient levels across both distribution channels. The mean content was 89.3% for samples obtained from street markets and 88.0% for those sourced from pharmacies both below the pharmacopoeial acceptance range (90–110%). The compliance rate was identical in both cases, with only 33% of samples meeting quality specifications.

These results indicate that quality deficiencies are not limited to the informal sector, but also affect products sold through regulated pharmaceutical outlets. The widespread underdosing observed is of particular concern, as it may significantly reduce the analgesic and anti-inflammatory efficacy of ibuprofen. Sub-therapeutic levels can result in inadequate pain management, prolongation of inflammatory conditions, and repeated dosing by patients seeking relief, thereby increasing the risk of misuse.

Possible explanations for the observed inconsistencies include poor manufacturing practices, degradation of the active ingredient due to inadequate storage conditions (e.g., exposure to heat or humidity), and the circulation of substandard or counterfeit formulations. These findings highlight the need for enhanced regulatory oversight and improved supply chain control to ensure the quality of ibuprofen available to the population.

3.4. Diclofenac sodium 50 mg

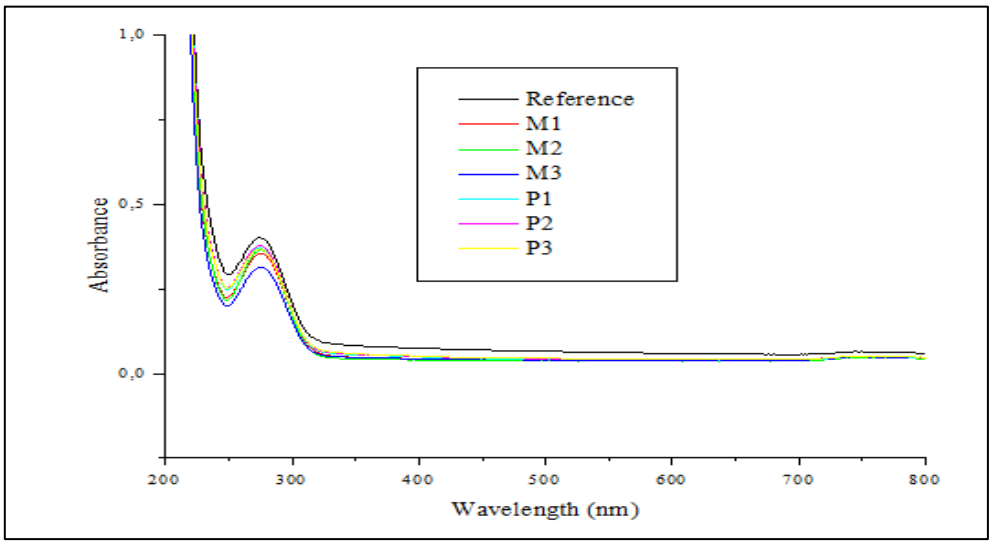

Fig. 5 : **Spectrum of diclofenac sodium**

Analysis of diclofenac sodium samples revealed a clear disparity in quality between distribution channels. Samples obtained from street markets showed a mean active ingredient content of 86.0%, with a compliance rate of only 33.3%, indicating that two-thirds of the samples failed to meet pharmacopoeial standards (90–110%). In contrast, samples sourced from pharmacies presented a mean content of 93.0%, with a 100% compliance rate, suggesting good manufacturing quality and proper storage conditions.

The low levels measured in street-market samples may significantly compromise the therapeutic effect of diclofenac, particularly in the management of moderate to severe inflammatory pain. Sub-therapeutic dosing can lead to treatment failure, persistence of symptoms, dose escalation by patients, and potential misuse of the drug. These deficiencies may stem from poor manufacturing practices, degradation during transport or storage, or the circulation of substandard or falsified products in informal markets.

Overall, the results underscore the public health risks associated with informal pharmaceutical distribution and highlight the need for strengthened regulatory mechanisms and systematic quality surveillance of anti-inflammatory drugs in Niger.

3.5. Tramadol 120 mg

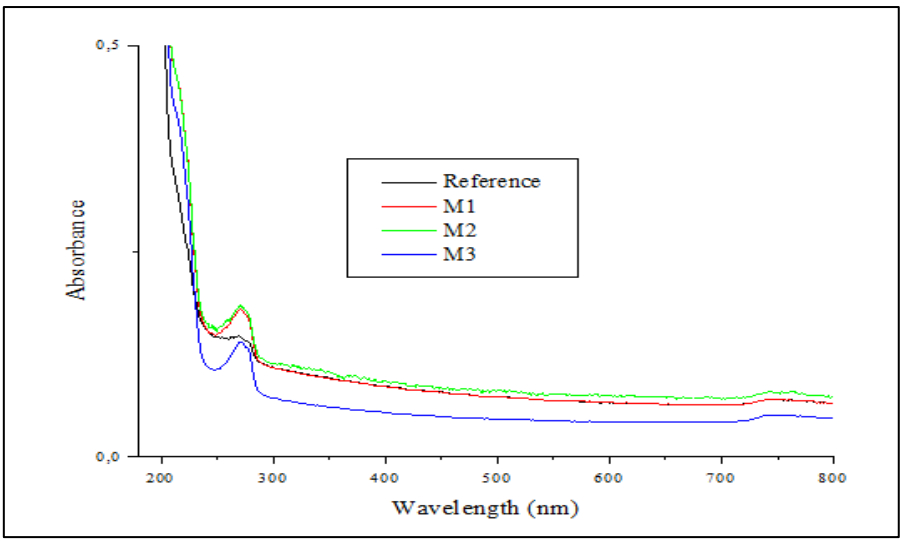

Fig. 6 : **Tramadol spectrum**

The analysis of tramadol samples collected from street markets revealed a mean active ingredient content of 114.5%, with a compliance rate of only 33%. Notably, two out of the three samples exceeded the upper pharmacopoeial limit of 110%, indicating significant overdosing. No tramadol samples from pharmacies were available for comparison, preventing an assessment of product quality in the formal sector.

The presence of overdosed tramadol in street markets poses serious public health risks. Excessive concentrations of tramadol can induce central nervous system depression, including respiratory depression, a potentially life-threatening adverse effect. Moreover, tramadol overdose significantly increases the risk of dependence and addiction, particularly in settings where medical supervision is limited. Other possible complications include seizures, severe dizziness, and serotonin syndrome, especially when taken concomitantly with other medications.

These findings highlight the dangers associated with the informal sale of controlled analgesics and underscore the urgent need for strict regulatory control, pharmacovigilance, and public awareness campaigns regarding the misuse and risks of opioid analgesics.

4. CONCLUSION

This study highlighted substantial differences in the quality of analgesics circulating in Niamey, particularly between products obtained from accredited pharmacies and those sold in the informal sector. The findings underscore the critical need for rigorous pharmaceutical quality control and sustained efforts to combat the circulation of substandard and falsified medicines in order to safeguard public health.

Of the 27 samples analysed, only 11 (40.74%) complied with the required dosage specifications, while 16 samples (59.26%) were non-compliant. Among these non-compliant products, 11 originated from the informal market, but importantly, 5 non-compliant samples were also obtained from approved pharmacies, indicating that quality issues are not limited to the street market and may reflect broader challenges in the pharmaceutical supply chain.

Overall, the results reveal significant variability in the quality of analgesics sold in Niamey, with a markedly higher risk associated with products purchased in street markets. Such discrepancies pose real and immediate health threats, including therapeutic failure, toxicity, development of drug resistance, and potential overdose-related complications.

This study emphasises the urgent need for strengthened regulatory oversight, improved supply chain monitoring, enhanced public awareness, and systematic laboratory quality control to ensure that all medicines regardless of their point of sale meet international pharmacopoeial standards.

Health authorities should :

- Strengthen drug quality control
- Prohibit the illegal sale of drugs
- Raise public awareness of the risks of counterfeit products

Recommendations:

- Intensify drug quality control
- Strengthen surveillance of street markets
- Raise public awareness of the risks associated with counterfeit drugs.

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